(Second Series)

Vol. 25—No. 1

Western Australia

JOURNAL

OF THE

DEPARTMENT OF AGRICULTURE

OF

WESTERN AUSTRALIA

Issued by Direction of

THE MINISTER FOR AGRICULTURE
Hon. G. B. WOOD

PUBLISHED QUARTERLY

All exchanges and correspondence should be addressed to
THE DIRECTOR, DEPARTMENT OF AGRICULTURE
PERTH, WESTERN AUSTRALIA

EDITOR — F. SAUNDERS

MARCH, 1949

By Authority: WILLIAM H. WYATT, Government Printer, Perth

1949

25197/3 49

IN AUSTRALIA MOST FARMERS USE

DUNLOP
LINKED-BAR
TRACTOR TYRES

Because—

1 DUNLOP *Pull* BETTER

Dunlop Linked-Bars penetrate and grip over the *full* tread width — right across the traction area — where the tyre exerts its greatest ground pressure. Therefore, Dunlop Tractor Tyres — the *only* linked-bar tractor tyres in Australia — *pull better* than any other make!

2 DUNLOP *Clean* BETTER

With Dunlop Linked Bars there are no slots — no sharp angles — no corners — to pick up trash and clog. And because Dunlop Linked Bars have a thrust action which automatically cleans the bars of soil — Dunlop *run cleaner* than any other tractor tyre!

3 DUNLOP *Ride* BETTER

Dunlop Linked-Bar Tread has greater bar area (up to 12 ft. more per tyre) to roll on more smoothly. NO jolting from bar to bar. The driver finds long hours less fatiguing. *No other* tractor tyre can give the smooth riding of Dunlop Linked-Bar Tread!

4 DUNLOP *Last* LONGER

Dunlop Linked-Bars (with up to 40 lbs. more rubber per tyre) form a continuous chain of support around the whole of the tread — provide a tremendously strong backbone which supports the entire casing — long life factors which ensure Dunlop Linked-Bar Tractor Tyres *outlasting* all others.

ASK YOUR NEIGHBOURS — 10 TO 1 THEY'LL RECOMMEND

DUNLOP
LINKED-BAR
TRACTOR TYRES

D.487

DUNLOP RUBBER AUSTRALIA LIMITED (INC. IN VIC.)

CONTENTS

		Page
WHEAT VARIETY TRIALS	J. Thomas and E. R. Watson	1
CAN WASHING MACHINES AND THEIR OPERATIONS	A. H. Hobbs	8
OATS IN THE WHEATBELT	J. Thomas and E. R. Watson	20
AN EXPERIENCE IN ARGENTINE ANT CONTROL....	P. N. Forte	29
BLACKLEG IN CATTLE	C. R. Toop	33
NEW CEREAL VARIETIES IN AUSTRALIA	J. Thomas	35
COST OF FEEDING PURE-BRED DAIRY COWS UNDER THE AUSTRALIAN OFFICIAL PURE-BRED HERD RECORDING SCHEME IN WESTERN AUSTRALIA, 1947–48	M. Cullity	36
THE SUNFLOWER	H. G. Elliott	44
COMPOSITION OF MILK	M. Cullity, J. C. Hood and K. Needham	49
THE COOLING OF MILK ON DAIRY FARMS	A. H. Hobbs	65
RESPONSES OF OATS TO ZINC, PHOSPHATE AND COPPER ON NEWLY CLEARED LIGHT LAND IN WESTERN AUSTRALIA	T. C. Dunne, S. T. Smith and H. G. Cariss	75
BUTTER-FAT READY RECKONER		83

IMPORTANT

TO INTENDING PURCHASERS OF USED TRACTORS

1 Certain second-hand Fordson Major Tractors described as "Factory reconditioned" and "Direct from England" are being offered for sale in Western Australia by other than authorised Fordson Dealers.

2 Ford Motor Company of Australia Pty. Ltd. wishes to make it clear that neither it nor Ford Motor Company of England Ltd. has reconditioned these units and that they are unable to give any guarantee in respect of them.

3 NEW Fordson Tractors sold through the Company's authorized Dealers and Distributors are fully backed by the manufacturer's warranty, and authorised Fordson Tractor Dealers stand behind any used Fordson tractors sold by them.

4 All Fordson Major Tractors sold through Authorised Fordson Dealers and Distributors are equipped with a range of wheel and tyre equipment especially designed for Australian conditions, and replacement parts are freely procurable from such Dealers throughout Australia.

5 Ford Motor Company of Australia Pty. Ltd. has no connection with any companies disposing of the "factory reconditioned" Fordson Major tractors referred to.

FORD MOTOR COMPANY OF AUSTRALIA PTY. LTD.

(INCORPORATED IN VICTORIA)

REGISTERED OFFICE GEELONG, VICTORIA

FM-835-24W

JOURNAL

OF THE

Department of Agriculture

OF

WESTERN AUSTRALIA

Vol. 26. (Second Series) MARCH, 1949. No. 1

WHEAT VARIETY TRIALS.

I. THOMAS—Superintendent of Wheat Farming and E. R. WATSON—Agricultural Adviser.

EACH year wheat variety trials are conducted on the wheatbelt Agricultural Research Stations to determine the varieties which can be recommended as being the most suitable for planting under West Australian conditions. Included in these trials are varieties introduced from other parts of Australia as well as the more promising crossbred varieties produced at the Research Stations in this State which have proved satisfactory in other respects.

Of all varieties grown in Western Australia, over 60 per cent. of the total area planted to wheat in 1947 was sown to varieties produced by this Department, and over 50 per cent. of the total area was represented by the varieties Bencubbin and Bungulla. These two are the standard recommended varieties and are used for comparison in all Research Station Wheat Variety Trials.

Prior to the inclusion of the crossbred varieties in these field yield trials they undergo various tests for disease resistance etc. and are placed in small scale or micro yield trials which sometimes include up to 200 crossbred and control varieties. Such small scale trials are a convenient method of eliminating crossbreds of lesser value with a minimum of seed requirements, and thus only the more promising are included in the field trials.

SEASONAL CONDITIONS.

Seasonal conditions throughout the wheatbelt varied considerably during 1948, and the following is a brief summary of the conditions experienced at each of the Research Stations:—

Avondale.—Very little rain was recorded before the month of June and consequently seeding operations were much later than usual. Despite the lateness of the opening rains 1,183 points were recorded for the growing period, which compares favourably with the average rainfall. There were heavy falls registered during the months of June, July, August and September with lighter falls in October and November. Most crops finished off reasonably well.

25197/48

Chapman.—Rainfall throughout the year was very light and well below the average for each month, only 787 points were recorded for the growing period, compared with an average of 1,542 points. No rain was recorded in May and only about half the average rainfall registered for June.

Merredin.—Following upon a good heavy rain at the end of April which allowed the fallow to be worked into good condition, no appreciable rains were recorded until the 6th June. Comparatively dry conditions were experienced during the remainder of the growing period and these together with the hot dry winds experienced in September and October caused severe setbacks to the crops. Good falls were recorded late in September, but they were too late to be of much benefit to the crops generally.

Salmon Gums.—Early rains recorded in February enabled the fallow to be worked into good condition. Following upon a good fall in April no appreciable rains were experienced until early June. Good falls were recorded in June, July and August and later falls in October resulted in quite good yields being obtained.

Wongan Hills.—Following upon the good rainfall registered in April no rain at all was recorded for the month of May; however, rainfall for the remainder of the growing period was satisfactory, except perhaps for October, when only 19 points were recorded, and crops generally made good growth.

Details of the rainfall recorded at each of the Research Stations are given in Table No. 1.

TABLE 1.

Station.	Year.	Jan.	Feb.	Mar.	Apl.	Growing Period Rainfall.							Nov.	Dec.	Annual Total.
						May.	June.	July.	Aug.	Sept.	Oct.	Total			
Avondale	1948	....	....	71	35	6	385	214	246	249	83	1,183	63	9	1,361
Average	22 years	23	34	101	79	217	337	308	240	106	80	1,288	53	31	1,609
Chapman	1948	....	....	34	105	....	257	220	198	97	15	787	46	....	972
Average	43 years	26	38	66	75	230	425	389	262	144	88	1,538	39	25	1,807
Merredin	1948	28	11	56	161	4	189	204	192	102	38	729	33	16	1,034
Average	37 years	42	53	95	90	136	196	185	153	81	75	826	42	55	1,203
Salmon Gums	1948	....	417	30	120	9	152	137	112	51	105	566	141	9	1,283
Average	23 years	80	87	139	93	121	151	142	146	91	112	763	91	76	1,329
Wongan Hills	1948	1	5	140	187	....	175	290	370	104	19	958	83	8	1,382
Average	23 years	33	45	96	96	187	270	261	208	91	70	1,087	45	40	1,442

DISEASE RESISTANCE.

As mentioned earlier in this article crossbred varieties are subjected to disease resistance tests in the earlier stages of selection as a variety is not considered to be valuable no matter what its inherent yielding capacity may be, unless it is capable of yielding satisfactorily under varying seasonal conditions and disease epidemics.

Flag smut.—All crossbred material as well as introduced varieties are subjected to flag smut tests whereby an actual epidemic of the disease is encouraged by inoculating the seed with flag smut spores prior to sowing. Resistance to flag smut is possessed by most varieties now being released by Australian plant breeders.

Stem rust.—Although fortunately this State is not subject to severe rust epidemics as frequently as the Eastern States, nevertheless the losses incurred in the two most recent epidemics of 1934 and 1943 were sufficient to warrant the endeavours to produce rust resistant varieties capable of yielding equally as well as the standard varieties which lack rust resistance. Only minor incidences of rust were reported in this State in 1948. As yet the biotype of rust race 34 which has now been isolated in each of the three Eastern States, New South Wales, Victoria and South Australia, has not been definitely recorded in this State, although it is anticipated that it will eventually be recorded here. Until such time as it is Eureka and other varieties deriving their rust resistance from the same source, e.g., Frisco and Wongoondy, may be regarded as rust resistant in this State. In the Eastern States where the biotype has been recorded they can no longer be regarded as resistant, and farmers look for varieties with either Kenya C6041, Kenya C6042 or mature plant type of resistance as described in Vol. XXV of this Journal, March, 1948. Such varieties include Dowerin, Charter, Yalta, Gabo, Kendee and those possessing the mature plant type of resistance, such as Celebration, Hofed, Febweb and Warigo.

Field day at the Wongan Hills Research Station. The farm manager, Mr. D. R. Bateman, explaining the layout of the wheat variety trials.

FLOUR STRENGTH.

A comprehensive description on flour strength and environment has been included in a previous article in this Journal, Vol. XXIV, March, 1947, pages 33 to 38. It is sufficient to repeat that one of the primary objectives in the wheat breeding programme of this Department is to raise the strength level of Western Australian wheat. An important point is that flour strength is directly related to soil fertility. Even though a variety has the inherent characteristic to produce flour of good baking quality unless the farmer maintains the fertility of his heavier land and builds up the fertility of the lighter soil types by the use of suitable legumes such as subterranean clover, peas, lupins, vetches, etc., it does not have the opportunity of expressing the true value of its grain quality.

FIELD TRIALS.

Rust resistant varieties produced in other States as well as several promising crossbreds from the Merredin Research Station were included in the 1948 trials. The results of the wheat variety trials carried out in that year are tabulated in Table No. 2.

TABLE II.

WHEAT VARIETY TRIALS AT RESEARCH STATIONS, 1948-1949 SEASON.

	Avondale.			Chapman.			Merredin.			Salmon Gums.			Wongan Hills.		
	Yield.	Percentage of Control.		Yield.	Percentage of Control.		Yield.	Percentage of Control.		Yield.	Percentage of Control.		Yield.	Percentage of Control.	
		1948.	Average*		1948.	Average*		1948.	Average*		1948.	Average*		1948.	Average*
EARLY MAY TRIAL.															
	Bus. lb.	%	%	Bus. lb.	%	%	Bus. lb.	%	%	Bus. lb.	%	%	Bus. lb.	%	%
Bencubbin	27 38	100	100	11 14	100	100	10 29	100	100	12 20	100	100	9 11	100	100
Eureka	28 29	103	(5) 104	13 46	123	(5) 94	10 18	98	(5) 80	11 42	95	(5) 83	7 9	78	(4) 85
Kondut	30 27	110	(5) 105	12 19	110	(5) 97	5 33	53	(5) 70	11 42	95	(5) 86	7 12	78	(4) 83
Yalta	26 45	97	(2) 89	12 48	114	(3) 95	11 23	108	....	10 46	87	....	6 42	73	....
Celebration	27 20	99	....	10 31	94	(2) 88	7 1	67	....	10 22	84	....	6 3	66	....
M.70 (Sword x Kenya)	20 13	73	....	12 31	111	....	10 31	100	....	11 2	89	....	6 43	73	....
Difference for Significance P = ± .05	4 2	15	....	0 37	5	....	1 18	12	....	0 45	6	....	0 55	10	....
LATE MAY TRIALS.															
SECTION I.															
Bungulla	23 44	100	100	20 51	100	100	16 34	100	100	14 18	100	100	8 23	100	100
Koorda	....	....	....	16 59	82	(4) 83	15 12	92	(4) 68	14 24	101	(4) 93	10 26	124	(4) 91
Frisco	....	....	....	18 21	88	(2) 92	17 30	106	(2) 104	....	....	....	9 55	118	(2) 89
Gabo	....	....	....	19 59	96	(2) 99	18 24	111	(3) 91	14 56	104	(2) 101	9 51	118	(2) 95
Kendee	24 35	103	(2) 124	16 21	78	(2) 93	14 43	89	(3) 84	15 16	107	(2) 102	8 58	107	(2) 91
Wongoondy	22 37	95	(2) 117	....	....	....	....	....	....	14 22	100	(3) 102	....	....	....
Dowerin	26 29	112	(3) 123	....	....	....	....	....	....	....	....	....	....	....	....
Charter	24 3	101	(2) 113	....	....	....	....	....	....	12 48	90	(4) 91	....	....	....
M.77	21 47	92	(4) 95	....	....	....	....	....	....	14 22	100	(3) 98	....	....	....
	27 57	118	....	....	....	....	....	....	....						
Difference for Significance P = ± .05	2 28	10	....	0 38	3	....	1 2	6	....	1 24	10	....	1 21	16	....
SECTION II.															
Bungulla	....	....	....	21 47	100	100	19 39	100	100	....	....	....	9 31	100	100
Charter	....	....	....	18 26	85	(3) 90	16 3	82	(5) 86	....	....	....	9 17	97	(3) 79
Dowerin	....	....	....	17 14	79	(3) 93	15 25	78	(3) 88	....	....	....	7 9	75	....
Wongoondy	....	....	....	19 47	91	(3) 97	18 35	96	(3) 106	....	....	....	8 10	86	(3) 88
M.77	....	....	....	20 34	94	(3) 111	20 3	102	(3) 106	....	....	....	9 12	97	(3) 90
M.88	....	....	....	....	....	....	17 15	87	....	....	....	....	....	....	....
M.90	....	....	....	....	....	....	18 13	92	....	....	....	....	....	....	....
Difference for Significance P = ± .05	....	....	....	2 6	10	....	0 52	5	....	....	....	....	1 2	11	....

* Number of trials indicated in parentheses.

NEW VARIETIES.

Although no further new varieties have been grown in the trials this year there are a number of Eastern States varieties included which have been introduced during the past few years, and the notes concerning these varieties which have been included in previous articles are represented in view of the possible importance of these varieties in this State. Notes concerning the two more recent new varieties produced by this Department, Dowerin and Wongoondy, are also included.

Celebration.—Produced by the New South Wales Department of Agriculture it is highly resistant to flag smut and stem rust, including the biotype of rust race 34 to which Eureka is susceptible. It has a mature plant type of resistance. The grain quality is good, being in the premium class, but results from the 1948 trials indicate that it has only average yielding ability under Western Australian conditions.

Portion of a Wheat Variety Trial—Merredin Research Station.
Each plot is one-eighth of an acre and is replicated five times in randomized blocks.

Frisco.—Bred by the New South Wales Department of Agriculture this early mid-season wheat derives its rust resistance from Eureka and therefore is susceptible to the Eureka attacking biotype of rust. It produces a grain of good quality and yields from the variety trials so far have been promising.

Gabo.—This is an early maturing wheat bred at the Sydney University. It is highly resistant to all races of stem rust known to occur in Australia, but is susceptible to flag smut. It has short strong straw and in the Eastern States has maintained high milling and baking quality when grown in differing climatic conditions. The results from trials conducted in Western Australia so far indicate that it is an early maturing variety especially suitable to the higher rainfall areas as it appears to need good finishing conditions to yield consistently well.

Kendee.—Kenya x Dundee—A mid-season maturing wheat bred at Sydney University and having the Kenya C.6042 type of rust resistance with a resistance to all known races of stem rust in Australia. It has strong straw and the grain

produces a medium strong flour under favourable conditions. Yields in Western Australian trials so far have been satisfactory, especially under higher rainfall conditions.

Yalta.—This midseason maturing variety bred by the New South Wales Department of Agriculture has a rust resistance similar to Kendee and is resistant to all known races of stem rust in Australia. The straw is of medium height, stands well and the baking quality of the grain is in the premium class. It is highly resistant, but not immune to flag smut. It was included in the variety trials for the first time in 1947, but due to poor germination caused by treatment to which the seed was subjected for the control of loose smut results for that year could not be regarded as reliable. However the 1948 results confirm the opinion that the variety will be a very suitable one for replacing Eureka as a midseason variety. A limited quantity of seed of this variety is now being distributed to farmers by this Department.

The initial step in the production of pedigree seed is the maintenance of a "pure line" which serves to keep varieties breeding true for the varietal characteristics.

Wongoondy.—This variety which was selected at the Merredin Research Station from a cross between Eureka and Bungulla is an early maturing variety which under suitable conditions produces grain approaching premium quality. It is a medium tall growing variety with a straw of excellent standing ability and holds its grain well. It is highly resistant to race 34 stem rust, but due to the fact that it derives its resistance from Eureka it is not resistant to the biotype of this rust race. This variety gives excellent promise and is favoured for its straw strength, earliness, prolificacy and its satisfactory grain quality.

Dowerin.—This variety was selected at the Merredin Research Station from a cross between Sword and Kenya C6041. It is resistant to all known races of stem rust in Australia, and is the only registered released variety which derives its resistance from this particular Kenya parent. An early mid-season maturing variety it is tall growing with fine straw and a tendency to weakness under certain conditions. The grain quality is in the upper range of the f.aq. It is resistant to flag smut and powdery mildew and has yielded well under trial particularly in the higher rainfall areas to which it seems to be most suited.

CROSSBREDS.

*M.*70.—Sword by Kenya C6041. An early maturing tall growing variety which is resistant to all known races of rust in Australia. It is similar to Dowerin.

*M.*77.—Eureka by Bencubbin. This early maturing variety has given promising yields, but is to be discarded from future trials as although its yielding ability is similar to Wongoondy the flour strength and straw strength are inferior to that variety.

*M.*88.—Eureka by Bencubbin. Tall growing wheat of good straw strength, highly resistant to race 34 of stem rust and moderately resistant to flag smut. It has yielded well in small scale yield trials and is being retained for further trial.

*M.*90.—Eureka by Bungulla. An early maturing variety which has been impressive in small scale trials, it is highly resistant to flag smut and race 34 of stem rust and produces grain of premium quality.

RECOMMENDED VARIETIES.

The standards adopted with regard to maturity of varieties in Western Australia has already been discussed in a previous article in this Journal Vol. XXV, No. 1, March, 1948, pages 92 to 94. A description of the recommended varieties which was included in that article is repeated here.

MIDSEASON.

Bencubbin.—This is the standard midseason variety which is the most extensively grown variety in Western Australia and also in Australia. Straw strength tends to be weak on light land, but is satisfactory for hay. Bencubbin is noted for its high yields under inferior seasonal conditions, but has been replaced by Bungulla by many farmers in the lower rainfall areas. It still remains the most prolific midseason variety for the Western Australian wheatbelt. It is resistant to flag smut but very susceptible to rust. Its flour strength is equal to the State f.a.q.

Kondut.—Has yielded well at Avondale for a number of years, but generally returns have been below Bencubbin. It is strong strawed and is recommended for planting on ploughed up clover land, on light land and under high rainfall conditions. Although not rust resistant it gives better yields under epidemic conditions than Bencubbin and Nabawa. It is resistant to flag smut, yields flour which is usually superior in strength to that of the f.a.q. and is strong strawed.

EARLY MATURING.

Dowerin and *Wongoondy.*—Descriptions of these varieties appear under the heading of New Varieties.

VERY EARLY MATURING.

Bungulla.—The standard early maturing variety which is a selection from Bencubbin. Like Bencubbin is notable for its high yields under low rainfall conditions. Because of its early maturity it usually suffers very little rust damage but it is not resistant to rust. It is resistant to flag smut. The increased popularity of this variety over the past five years in an indication of its value in the Western Australian wheatbelt, especially in the lower rainfall areas where it has produced consistently under very unfavourable climatic conditions. It is used extensively

for planting on ploughed up pasture land and was sown to 23.8 per cent. of the 1947 acreage sown to wheat for all purposes. Its main disadvantage is that it tends to be weak strawed, especially on light land and tends to lodge if sown before the third or fourth weeks of May.

Koorda.—A relatively recent release by the Western Australian Department of Agriculture, Koorda has yielded well on the lighter soils where its strong straw is of great value. Koorda is practically immune to flag smut and tends to be rust resistant in all but the heaviest epidemics. Flour strength of Koorda is about the same as that of the f.a.q. standard. It has gained popularity in this State during the past few years.

ACKNOWLEDGMENTS.

This opportunity is taken of expressing thanks to the Managers and staff of the Research Stations for their assistance in conducting the above trials.

REFERENCES.

W. P. Cass Smith and A. J. Millington (1944): Stem Rust of Wheat—Jnl. of W.A. Dept. of Agric., Vol. XXI.

A. T. Pugsley (1946): Private Communication.

L. W. Samuel (1938): Flour Quality—Jnl. of W.A. Dept. of Agric., Vol. XV.

L. W. Samuel (1945): The Influence of Some Crop Rotations and Fertilisers on the Strength of Wheat in W.A.—Jnl. of W.A. Dept. of Agric., Vol. XXII.

I. A. Watson and W. L. Waterhouse: "A Third Factor for Resistance," "Nature," 17th February, 1945.

I. Thomas, L. W. Samuel and A. J. Millington: "Wheat Variety Trials on Research Stations"—Jnl. of W.A. Dept. of Agric., Vol. XXIV.

CAN WASHING MACHINES AND THEIR OPERATIONS.

A. H. HOBBS, H.D.D. Dairy Produce Inspector.

THE final container used in the production of milk or cream, is the can in which it is transported to the factory. The length of time the product remains in the can may vary from some hours in the case of milk to two or three days in the case of cream, therefore, it is of major importance that the cleanliness of the can when it receives the milk or cream should be of a high order.

There is some difference of opinion as to where the responsibility for the can's cleanliness lies. Some factory proprietors maintain that the onus is on the producer, since he is the owner of the product up to the point of sale i.e. the factory receiving floor; but it should be realised that if the farmer forwards his product in a clean can the can should be clean when returned to him. Further, as illustrated in Table I the Bacteriological influence of the can on the quality of the raw product is by no means small, and anything that the factory owner can do to improve it will ultimately be reflected by improvement in his manufactured article.

The W.A. Dairy Industry Act provides that "Suitable can washing and can storage accommodation shall be provided in every dairy produce factory or depot". It is the object of this article to discuss the suitability of the accommodation at

present in existence in this State, and at the same time to suggest ways in which it may be improved to ensure that the cans are returned to the farms in the best possible condition from a bacteriological point of view.

Bacteriological Influence of the Can on the Raw Product.

The following results, Table I, of the examination of washed milk cans at treatment plants were obtained during an investigation of the milk supply of a large American city. They serve to illustrate the high proportion of the bacterial content of the raw product which may be contributed by the improperly washed and dried can.

The physical condition of the interior of the cans was first noted i.e. whether wet or dry, and the odour classified as good, close, sour, or foul. 184 cans were examined of which 50 were dry and 134 wet.

An estimate was made from each count, of the number of bacteria which would be added per c.c. of milk placed in each can.

TABLE I.

	Dry Cans.		Wet Cans.	
	No.	%	No.	%
Physical Examination—				
Odour O.K.	40	80	5	3.7
Odour Close	3	6	39	29.0
Odour Sour or Foul	7	14	90	67.1
	50	100	134	99.8
Bacteriological Examination—				
Less than 1,000 per c.c.	33	70.2	13	10.0
1,000 to 10,000 per c.c.	5	10.6	6	4.6
10,000 to 25,000 per c.c.	4	8.5	6	4.6
25,000 to 50,000 per c.c.	1	2.3	10	7.6
Over 50,000 per c.c.	4	8.5	95	73.0
	*47	100.1	†130	99.8

* Three cans not examined bacteriologically that were examined physically.

† Four cans not examined bacteriologically that were examined physically.

These results show that 73 per cent. of the wet cans would transmit an initial bacterial contamination to milk placed in them exceeding 50,000 bacteria per c.c., and only 3 per cent. of these cans gave an odour which could be classified as O.K. Of the dry cans, 80 per cent, gave an odour which could be classified as O.K. and 70 per cent. gave a calculated contamination to the milk of less than 1,000 per c.c.

Investigators have shown that milk even when produced under unclean conditions seldom has an initial count exceeding 20,000 bacteria per c.c. Thus it can be readily seen that the dirty can may introduce more bacteria to the milk or cream than is usually introduced by careless methods of milking.

With regard to the cleansing and sterilising of cans, the first thought that comes to mind is that the cans themselves should be in a good state of repair. In some large treatment plants in the United States of America, a system of can selection is practised, i.e., the cans are examined on the conveyor after being tipped, and any which are in a bad state of repair, or excessively dirty, are not allowed to pollute the solutions in the machine, but are put aside to be either scrubbed by hand, or sent to the repair shop or discarded altogether. It is not possible to effectively cleanse and sterilise cans which are badly pitted or cracked.

From the work of the various investigators into the problem of mechanical can washing, there arise three salient points:—

1. The need for abundance of water and steam at adequate pressures.
2. The removal of as much as possible of the residue of milk or cream from the can before it is subjected to the cleansing process.
3. Arrangement of the various temperatures throughout the process so that the can will be delivered from the washer dry, or so hot that it will dry almost immediately.

Temperature bears a somewhat similar relation to the can washing process, to that borne by cleanliness to the manufacturing process. In the factory, despite the improvement which has taken place in the design of processing machinery, cleanliness still remains the major factor in turning out a good quality article; so with the can washing process, no matter how elaborate the construction of the machine, temperature, and the time-temperature combinations are the major factors in turning out a clean sterile can.

As with other factory plant, there is need for careful planning of the can washing layout to minimise the drudgery which has been a feature of this work in the past. It is only in this way that the operator can be expected to take an interest in the work, and the operator is a very important link in any mechanical set up.

In contemplating the installation of a new can washer, consideration of the following points may serve to ensure that satisfaction will be obtained for the considerable capital outlay involved.

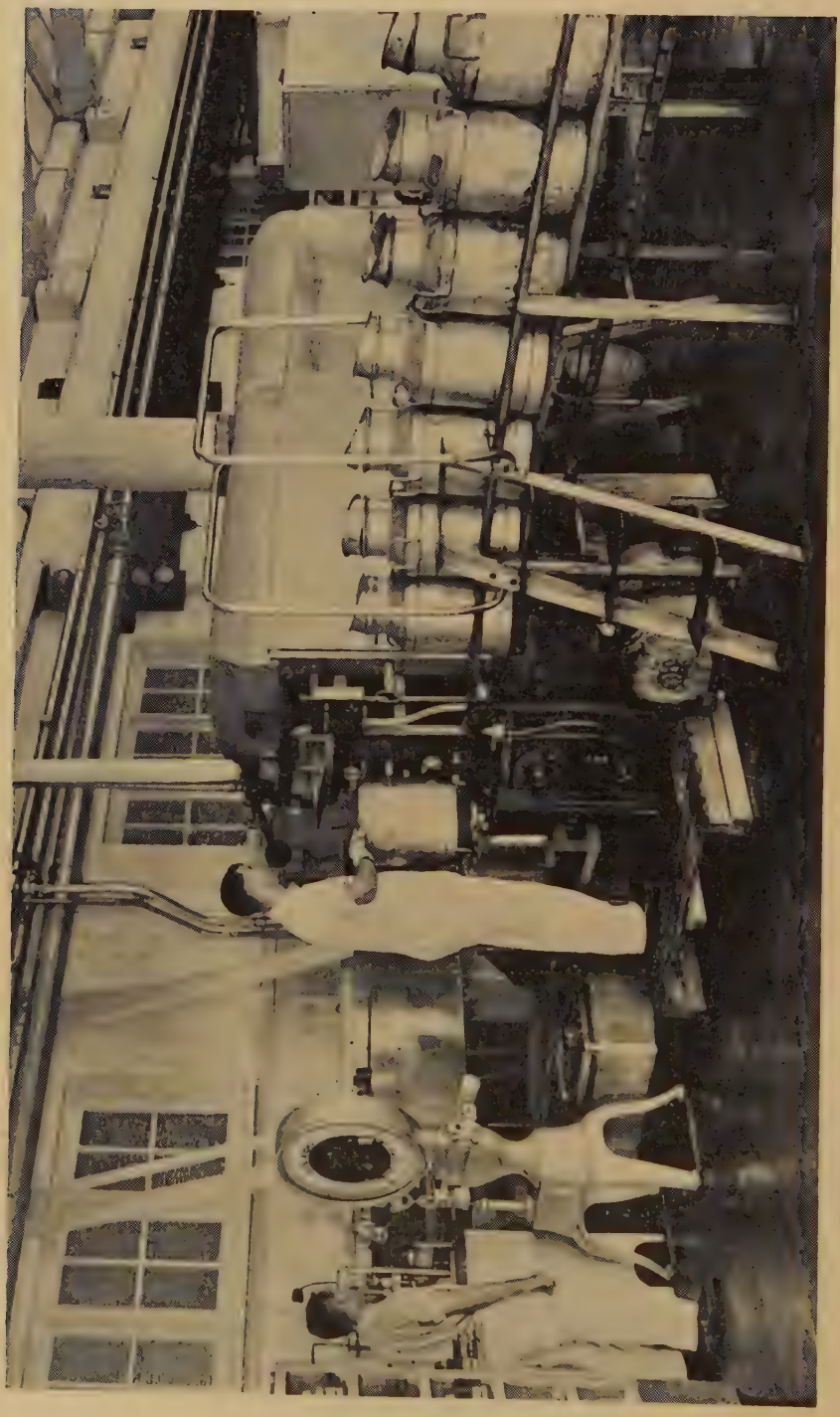
1. Adequate space should be alloted so that pumps, jets, strainers, etc., will be readily accessible for inspection and cleaning, and that the driving mechanism is situated well clear of cans and operator.
2. The capacity of the machine should be based on the number of cans received, in such a way that the cans will be treated in a continuous flow to prevent congestion, e.g. it is frequently found in butter factories, that with a can intake of say 800 per day, 600 of these arrive in the afternoon. In such cases, it would be desirable to have facilities to handle 600 cans in 2-3 hours. It is much easier to wash cans immediately after tipping than if the milk or cream residues are allowed to dry.
3. Can washing machines to be efficient require copious quantities of steam and water. The detergent and rinse tanks usually have to be filled quickly and heated quickly. Water pipes should be not less than 1in. in diameter. This means a 2in. main to the machine. Quick heating and the maintenance of high temperatures while the machine is in operation create a serious drain on boiler capacity, and since can washing and pasteurisation usually proceed at the same time, if the boiler capacity is inadequate, this may result in inefficient treatment of the product.

4. A very necessary improvement in modern can washers and one which is receiving attention by machine manufacturers is the exhausting of the used steam from the machine. If the operator is forced to work in a cloud of steam he will be tempted, to reduce the steam flow to improve his working conditions, and it would be unjust to expect him to take the blame for unclean cans when the conditions are beyond his control. This is a bad feature with the flat topped rotary machines in use in this State. Unless they are placed well out in the open, there is always a cloud of steam in front of the loading bay, providing the temperatures are being maintained at the desired point. The operator is surrounded by steam and has to grope in the machine to find the cans. The "straight through" type of machine lends itself much more readily to the exhausting of the used steam, because its construction is such that the steam can be drawn from both ends towards the centre, and the steam uptake is placed in the centre of the hood.

5. In the case of milk cans a conveyor from the tipping point to the washer, equipped with a drip tray, on which the cans are inverted will ensure that they are in the best possible condition for washing when they reach the machine. On some of the more modern machines these draining extensions are standard equipment, and on some "straight through" types the cans and lids are fed automatically from the conveyor to the washer.

6. In some countries the capacity of cans varies greatly, the largest being as high as 25 gallons. Fortunately, in this State there are no "outsize" cans, the 11 gallon taper being the largest used. Hence a washer constructed to take these is suitable for all types of can in use. However, high pressure jetting is used to replace the scrubbing of cans washed by hand, and considerable jet pressure is required to efficiently cleanse these tall cans; much greater than that required for 3 gallon cream cans. In machines constructed to handle all types of can in use, the jet pressure should be considerably greater than the maximum required to cleanse the small can. Where the lid is jetted at the same pressure, some means of securing it to prevent misplacement is essential, otherwise the lid will not be cleaned effectively. The condition of the lid is just as important as that of the can.

   There is a pressing need for the standardisation of can capacities. The industry has now reached a stage where the liquid product at any handling stage can be efficiently and economically handled in the standard 10 gallon milk can and the 5 gallon cream can, the former being used for either milk or cream. The construction of a machine to wash and sterilise cans of a standard type would be simplified immensely.



Straight through can washer In the foreground is the milk receiving, tipping and weighing equipment.
Photo by courtesy "The Hunter Valley Co-op. Dairy Coy. Ltd." Hexham. N.S.W.

7. Increasing attention is being given on up to date can washers to thermostatic temperature control plus recording thermometers on the washing and rinsing sections, thus eliminating the human control factor. Equipment of this nature however, is costly and is perhaps only warranted in factories of large output. Good results can be obtained by mounting dial thermometers and jet presssure gauges on a solid panel, with the control valves for the various sections arranged alongside. This will enable the operator to see at a glance whether the desired temperatures and pressures are being maintained, and to make the necessary adjustments, while still attending to loading and unloading of the machine. It is awkward and dangerous for the operator to take the temperature of the solutions in a machine which is in operation, with an ordinary dairy thermometer; also the fragile nature of dairy thermometers precludes their satisfactory use for this purpose.

   The pressure gauge is the only accurate method of ascertaining whether the pump is delivering at full pressure. Hot solutions are frequently difficult to "pick up," especially if there is foam present. Further, if for any reason the impellor becomes partially choked, the pressure at the jets may be appreciably lowered without being discernible while the machine is in operation. The pressure gauge may not detect blocked jets, but it will indicate practically all other pump troubles.

Maintenance.—It is well to remember that a machine will not do the job required of it unless operated and serviced as the manufacturer intended. The operator is responsible for cleaning jets, etc. and the general sanitary condition of the machine, but this is not all that is required. Regular lubrication of the moving parts with the correct grades of lubricant is of vital importance to the efficiency and useful life of the machine. This should be the responsibility of the trained factory engineer. All too frequently it is found that little or nothing is done towards servicing the machine until the operator informs the engineer or foreman that some section is giving trouble.

The Water Supply.—Very few factories are equipped with water conditioning plants, and hence the water is used in the condition in which it leaves its source. Often this is quite suitable; but where the water is known to be hard and is not treated prior to use in the factory, some conditioning agent should be used to assist in preventing the formation of scale in pumps, pipes etc. and the gradual building up of milk stone in the cans.

Choosing a Detergent.—In the choice of a suitable cleanser for use in the can washer there are several things to consider, not the least of which is price. Proprietary cleansers suitable for washing tinware usually contain a high proportion of soda ash as a base. Soda ash is cheap in comparison with other alkalis and its use in the right proportion with good quality water is quite suitable for cleaning tinware. Its water softening qualities and wetting power however, are limited, and with the water supplies available for mechanical washers in most factories, the addition of substances which combine wetting, free rinsing and scale preventing properties is desirable. This is important, for in the mechanical can washer, the can is subjected to the detergent jetting for a short period only, and therefore, good wetting and rinsing qualities are more essential in a cleanser for this purpose than for washing tinware in other sections of the factory plant.

Using soda ash as a base, the addition of smaller amounts of Sodium metasilicate, tri sodium phosphate and sodium Hexametaphosphate will give a mixture which will produce the necessary reactions in a wade range of waters to give satisfactory cleansing results and trouble free running of the machine.

A combination of the above ingredients in the following proportions is recommended.

Soda Ash	54%	£19.1.0. per ton
Sodium Metasilicate	15%	£45.0.0. per ton
Tri SodiumPhosphate	20%	£53.5.0 per ton
Calgon (Sodium Hexametaphosphate)	11%	1/4½ per lb.
	100%	

Soda Ash forms the bulk of this mixture and is the cheapest cleanser available. Sodium metasilicate and tri sodium phosphate are very effective against protein solids and fats, are good wetting agents and rinse freely. Calgon is the water conditioning agent; its object is to maintain the mineral content of the water in solution and prevent it being deposited in the form of scale on the metal surfaces of the machine and cans. By so doing, it increases the softness of the water and improves the rinsability of the solution.

Sodium metasilicate is at present difficult to obtain but it may be replaced in the above mixture by increasing the quantity of soda ash.

This mixture is used at a concentration of .3% (3lb. per 100 gallons) and is suitable for use on all tinware in the factory plant, but it should be remembered that a hard water requires more cleanser than a soft water to produce a given alkalinity.

Because the usual factory practice is to use the one cleanser for the majority of cleaning operations, the preparation of stock solutions is of economic importance. The indiscriminate measuring out of small quantities of dry cleanser by several members of the factory staff is usually wasteful and results in solutions being used at varying strengths. In addition the dry cleanser is often dumped into the receptacle in which the washing is to be done, and sinks to the bottom where it forms a concentrated solution immediately surrounding it. If the receptacle happens to be a tinned vat, the result is the removal of a section of the tin. A similar quantity of a stock solution poured into a receptacle of water immediately disperses, and this trouble is prevented. Stock solutions are usually made up to 10 per cent. concentration. All that is required is a steel tank, slightly elevated, equipped with a stirring device and preferably connected by piping to the various points at which the solution is to be used. A suitable measure can be provided at each point.

As soda ash is marketed in bags containing 190 lb. it may be desired to prepare a stock solution using a full bag of soda ash as a base. In this case, assuming sodium metasilicate was not procurable the quantities of each ingredient would be:—

	lb.
Soda Ash	190
Tri Sodium Phosphate	55
Calgon	30
	275

This quantity should then be dissolved in 275 gallons of water to give a 10 per cent. solution. If a proprietary cleanser is to be used the stock solution is prepared similarly by adding 1 lb. of the cleanser to 1 gallon of water.

As can be seen from the summary of procedure at the various factories, an endeavour is often made to offset the mechanical inefficiency of the machine by increasing the concentration of the detergent solution. Properly pre-rinsed cans can be cleaned effectively with a concentration of .3 per cent., and it is unnecessary and costly to use concentrations above this figure. It is much more important that the pumps and jets are working to capacity and the cans are properly centred over the jets, so that a vigorous jetting is applied to all parts of the can and lid. If this is not occurring, the cleaning will not be done properly even though the concentration of the solution be doubled or trebled.

It is necessary however, to maintain the solution at .3 per cent. continuously. This is done by adding the requisite quantities of cleanser at specified intervals depending on the rate of reduction of alkalinity.

Testing the Strength of Detergent Solutions.—Equipment is now available which automatically registers the pH of the solution and determines the quantity of cleanser to add in order to maintain the correct concentration.

If this equipment is not provided, the alkalinity of the solution may be estimated in the following way:—

Apparatus Required:

25 ml. burette.
10 ml. pipette.
Porcelain dish.
N/10. Hydrochloric Acid.
Phenolphthalein Solution (as used for estimating the acidity of Cream or Milk).

Method.—From the well mixed solution in the detergent tank on the washer, procure a sample, and pipette 10 ml. into the porcelain dish. Add five drops of phenolphthalein and titrate with N/10 Hydrochloric Acid until the pink colour disappears. No. of mls. N/10 Hydrochloric Acid required X.04=% available alkalinity i.e., the alkalinity to phenolphthalein calculated as caustic soda.

Example.—Ten mls, of solution required 15 mls. of N/10 Hydrochloric Acid for neutralisation. Available alkalinity=15 X .04=.6%.

The capacity of the detergent tank should be first carefully ascertained, and sufficient cleanser added to give a .3 per cent. solution. If this is then tested for available alkalinity, the result obtained can be used as a standard with which to compare results of future samples, and for calculating the quantity of cleanser to add as the alkalinity of the solution in the tank decreases.

THE PROCESS.

The following table gives the recommended procedure with the various types of machines and cans:—

	Rotary.		Straight Through.	
	Milk Cans.	Cream Cans.	Milk Cans.	Cream Cans.
Pre-rinse Temperature	Not above 110°F.	Up to 130°F.	Not above 110°F.	Up to 130°F.
Detergent Temperature	180°F.	180°F.	150°F.	160°F.
Concentration	.3%	.3%	.3%	.3%
Hot Water Rinse Temperature	....	....	200°F.	200°F.
Steam Blast	50–100 lbs. pressure		50–100 lbs. pressure.	
Air Blast	Hot as possible		Hot as possible	

The Pre-Rinse.—All machines should be equipped with a pre-rinse section. The reason is obvious with milk cans, and even though cream cans may appear to have been completely rinsed on the cream saver, a further rinse gives the advantage of having the can surfaces warm and wet when they contact the detergent jet.

The pre-rinsing jet is usually direct from the main and whilst this is suitable and preferable for milk cans some means of warming the water would be more effective for cream cans. A control valve is necessary to minimise water consumption. The water used for the pre-rinse should be allowed to drain from the can and run outside the machine to the factory effluent drain to obviate fouling of the detergent solution.

Washing.—The detergent (.3 per cent. solution) should be sprayed vigorously into the can and lid at jet pressures of not less than 25 lb. per square inch. It has been estimated that at this pressure a minimum of three gallons of solution will be injected into the can, the actual quantity depending on the size of the apertures in the jet and the length of time the can is over it.

The cleansing and sterilising process may vary within restricted limits depending on the type of machine. In most rotary machines in use in this State, there is no hot water rinse; the rinsing out of the detergent solution and final sterilisation is accomplished by means of a jet of wet or saturated steam. Most "straight through" types have a hot water rinse between the detergent and steam sections. Therefore to obtain the required can temperature for effective sterilisation and drying from the steam jet and air blast in the rotary machine, it is necessary for the detergent solution to be hotter than with the other type. Some investigators have pointed out that there is a temperature limit to the effectiveness of cleansing solutions in respect to dairy equipment, above which there is a tendency for the milk residues to be baked on rather than removed. The temperature at which baking on is expected to commence is placed at 140°F. This however, is not so important if the pre-rinse has been thorough, and does not apply to the same extent with cream cans because of the high concentration of fat in the product, and the fact that the cans may have already been subjected to higher temperatures than this when in contact with the cream saver.

Stage at which to Replace the Detergent Solution.—There can be no hard and fast rule as to the number of cans which can be washed before replacing the cleansing solution. This depends on:—

1. The capacity of the detergent tank.
2. The degree of removal of milk residues from the cans at the tipping point and during subsequent draining.
3. The efficiency of the pre-rinse.

Solutions for cleaning tinware must be of necessity weak in comparison with those used for other purposes, e.g., bottle washing, to prevent corrosion of the tin. The effectiveness of a weak cleansing solution is dependent not so much on its strength, as on its volume in comparison to the amount of soiling material which it has to handle. For example, in washing say 200 cans, a much better result, for the same cleanser costs, would be obtained by using 200 gallons of solution at .3 per cent. concentration than with 100 gallons at .6 per cent. It may be argued that the cost of heating so much water would be prohibitive, but considering that in the butter factory the recommended procedure for washing a churn absorbs (for a 30 box churn) roughly 400 gallons of boiling water, it

is not unreasonable to use 100 gallons of hot water to wash 100 cans. It is recommended that 100 cans be the maximum number to be washed with 100 gallons of solution irrespective of its concentration.

The fat removed from the cans in the washer is not dissolved, but is in the form of an emulsion in the cleansing solution. Therefore it is obvious that as the fat content of the solution increases, so its ability to remove fat from the cans decreases.

The replacing of the solution can only be worked out under each factory's conditions, and may vary considerably between factories.

An appreciable saving in cleanser costs is possible by maintaining an efficient pre-rinse, thus reducing the work to be done by the cleansing solution, and increasing the number of cans which may be washed before replacing it.

The Hot Water Rinse.—Machines equipped with a hot water rinse possess two desirable advantages:—

1. Complete rinsing of the cleansing solution from the can.
2. An extra jet in the treatment line delivering water at near boiling point, thereby raising the can temperature to an effective sterilising point before it reaches the steam jet.

There should be a draining stage between the cleansing section and the hot water rinse, to reduce carry over of the detergent solution.

The water in the rinse tank should be changed frequently, or a small controlled flow of fresh water be allowed to enter at the bottom of the tank continuously.

The Steam Jet.—Steam pressures of 50-100 lb. per square inch should be available. On modern machines this section is equipped with a hot water-steam mixing device or ejector so that the jet comprises a mixture of water and steam. The important point here is that certain time-temperature combinations are essential to produce complete sterilisation, therefore because the can is over the jet for a specified short time only, it is necessary that the steam pressure and temperature be sufficient to bring about sterilisation in that time.

Air Blast.—The air blast in the majority of machines at present in use in Western Australia receives its heat as it passes through a coil or drum submerged in either the detergent or rinse tank. In some of the more modern ones the air passes over a steam heated radiator. The maximum air temperature available with this method is about 135°F.-150°F. depending on the air flow, therefore it is not expected that the air should have any sterilising effect. Its object is to dry out the can by moisture absorption; and its ability to absorb moisture increases with the temperature. The hotter the can when it contacts the air blast, the more easily will the moisture be removed.

With the usual can handling operations in factories the necessity for prompt return of cans to rail or road transport will not permit that time be allowed for cans to be inverted to drain. Thus if the machine drying has been incomplete, varying amounts of water are left in the can which become a breeding ground for micro-organisms.

Washing Cans by Hand.—Broadly speaking the conditions which apply to machine washing apply also to hand washing.

The operation is usually carried out with the aid of brushes, in a tub or vat of relatively small capacity. It is therefore very necessary that the cans be well rinsed with water from a hose or other jet before being placed in the cleansing tub, to prevent fouling of the solution. In addition the solution in the tub should be changed frequently. Scrubbing should be vigorous paying particular attention to corners and shoulders.

Because the hands come in contact with the washing solution, the temperature must be not higher than can be comfortably borne i.e., 130-135°F. The detergent mixture mentioned previously is suitable, or if the water is of good quality, soda ash alone (.2%-.3% solution) may be used with success. A second tub containing fresh water at 160°F. for rinsing is desirable.

The brushes used in hand washing may be a serious source of contamination if neglected. They should have stiff bristles and a stiff wing at one or both ends and should not be allowed to become foul from decomposing milk solids. The odour of a brush is a good indication of the bacterial activity which has taken place in it.

Usually where hand washing is practised there is sufficient time after the completion of the process for the cans to be inverted on racks to drain, therefore if the cans and lids are sterilised by inverting over a steam jet at 50 lb. per square inch pressure for at least one minute and then drained on racks, the results should be satisfactory.

The following summary of methods and equipment in use in the factories in this State has been prepared from the results of a survey, recently conducted by Field Officers of the Dairy Branch.

1. In all factories visited, except one, rotary machines were installed.
2. In some factories the cans were pre-rinsed, but in most of these it was done only as a means of saving cream, i.e., the rinsing was done by the steam jet on the cream saver. Only one factory was equipped with a pre-rinsing jet on the machine.
3. Detergent solution temperatures varied between 130°-200°F.
4. Detergent strength varied between .05 per cent. and .6 per cent. Practically all factories were using soda ash alone. In one, a mixed cleanser was used consisting of soda ash, sodium metasilicate, soft soap and calgon. This mixture was used at .15 per cent. and this factory appeared to be getting the best results of all those visited.
5. There were no tests taken for alkalinity.
6. In only one case was there any temperature control. This was thermostatic on the cleanser tank. There were no thermometers on any machine.
7. Three machines were equipped with either a hot water rinse or saturated steam jet. Even in these there was no means of ascertaining the temperature other than dairy thermometers.
8. On four machines, although steam jets were provided, they were not working. Cans were steamed in all other cases.
9. All machines, except one, were equipped with an air blast, all of which were working, but in only two cases were cans dried satisfactorily.

10. Only one machine was equipped with a used steam exhaust.

11. The number of cans washed per change of detergent solution varied from 100 to 600. Capacity of detergent tanks varied between 70 gallons and 200 gallons, hence in some cases as many as 600 cans were washed with 200 gallons of solution, and the cans were not pre-rinsed.

12. In only two cases were cans washed and dried satisfactorily.

One officer's remarks regarding the condition of washed cans at a factory where the methods and equipment were poor, were as follows:—

"Conditions of cans at time of visit was very poor. A brown scum was noticeable and could be scraped off a great number of cans. Cans were not dry. Water was too cold to obtain efficiency."

To illustrate the importance attached to the subject of can washing in England the following list of treatment stages for both cans and lids recommended for a well designed machine is given:—

1. Pre-rinse with cold or warm water.
2. Draining stage.
3. Pump pressure fed jetting with detergent (or hot water) at not less than 160° F.
4. Draining stage.
5. Pressure rinsing stage, pump fed or by steam ejector at 180° F.
6. Final fresh water rinsing with steam ejector at 180-200° F. (This and the previous stage is often combined on small output machines).
7. Live steam injection.
8. Hot air drying at 180-220° F.

At first glance this appears somewhat of a factory manager's dream. The fact remains that the industry in this State is fast approaching a stage where large numbers of cans have to be handled promptly, and efficiently in factories of ever increasing output.

The labour available has long deplored the drudgery attached to can washing, and will neglect the job where it is difficult. As the size of the job increases under inefficient conditions, so the drudgery increases, and the important points associated with cleansing and sterilising are neglected.

It behoves the proprietors of all dairy produce factories in Western Australia to give this matter careful consideration, with the end in view of improving the quality of our butter, cheese and condensed milk through improvement in the quality of the raw product.

REFERENCES.

R. O. Webster. Bureau of Chemistry, Department of Agriculture, United States of America.

J. H. Dick, Technical Officer, I.C.I., Melbourne. Address 1947 Conference of Australian Inst. Dairy Factory Managers and Secretaries Inc.

A. F. H. Briscoe, U.D. Engineering Company, Ltd., London, Paper Annual General Meeting Soc. of Dairy Technology.

OATS IN THE WHEATBELT.

I. THOMAS—Superintendent of Wheat Farming.

E. R. WATSON—Agricultural Adviser.

IN the early history of the development of the wheatbelt of this State the growing of oats was of comparatively minor importance and for some time was confined to the more favourable rainfall areas. However, as the need for greater diversification of agriculture in the wheatbelt was appreciated, stock became an important adjunct to wheat farming, and with the increase in the number of stock, mainly sheep, the area of oats increased considerably. Although the acreage of wheat has fluctuated considerably from time to time, that of oats has shown a more even increase. The acreage of oats grown for all purposes in 1947-48 was 878,777 of which 278,184 were for green feed.

The increase in the area sown has been made possible to a large degree by the development of early maturing oat varieties suited to the drier areas of the wheatbelt. That oats have became an integral part of the wheatbelt programme can be appreciated from the fact that the acreage of this cereal is now approximately one third of that of wheat.

As an alternative crop to wheat it is invaluable to the wheat farmer in that its cultivation fits in well with his cropping programme. When grown for green fodder seeding can be commenced prior to the main cropping programme and when the crop is grown for grain it can usually be harvested before the wheat crop is ready.

From the disease point of view it is a useful crop for a wheatbelt rotation, as it is resistant to wheat rust, "foot rot" and "Take all." As has previously been recommended a year of fallow followed by an oat crop gives the spores of these latter disease organisms opportunity to germinate in the absence of favourable host plants and thus effects a measure of control. The fact that oats are less liable to malting permits of earlier sowing in the absence of sufficient moisture for germination which is a valuable characteristic in seasons when the opening rains are belated.

As indicated earlier oats are used extensively for grazing. This practice not only increases the stock carrying capacity but also assists in maintaining and improving the fertility of the land because of the organic matter which is returned to the soil.

However, although oats serve many useful purposes in the wheatbelt rotation it must be remembered that they are also a cereal crop and very closely resemble wheat and barley in their nutritional requirements.

So far as their value as a fodder crop is concerned they come into three main categories.

(a) Sown Specifically for Grazing.

The larger portion of the crop for this purpose is sown on wheat stubble land which is broken up with the first autumn rains. These crops provide a green "bite" in the earlier part of the season and in about five to six weeks from germination in many instances carry five to 10 sheep per acre for a period of 10 to 14 days. They may be grazed outright or left to recover for grain. Beside the fact that they provide a bulk of green feed earlier than natural

pastures, their utilisation in the early part of the season allows the natural pastures to make a body of feed before they need to be fed off. This tends to prevent selective grazing of the young pasture plants with the possible elimination of desirable types which are more palatable in their early growth stages. Oats also provide an excellent cover grazing crop in the first year of establishment of subterranean clover and other pastures. Cereal crops grown for early green feed are invaluable to fat lamb producers, and the same crop can be used for topping off lambs in the spring when grass seeds are a nuisance.

(*b*) *Sown for Hay.*

With the increasing difficulty in obtaining efficient labour and the high cost of wages, the high labour requirements of hay cutting now act against its extension. However, cereal hay is still a valuable fodder and the increasing mechanisation of hay baling may possibly favour larger areas of cereal being cut for hay.

The time of cutting cereal hay has a marked effect on both maximum yield and total digestible nutrients. The maximum yields of total digestible nutrients are obtained by cutting wheaten hay at the late milk stage and oaten hay at the early dough stage of grain formation. These times of cutting correspond with times of maximum total yield of hay (Underwood and Moir, 1947).

(*c*) *Sown for Grain.*

Results and comparisons of hay and grain yields give support to the conservation of cereal hay rather than grain. However, the total yields of dry matter are not the only consideration and cereal hay cut at any reasonable growth stage is a roughage of comparatively low digestibility and a very low content of digestible protein. Grain, on the other hand, is a concentrate, particularly well adapted for supplementing the poor dry grazing of the summer months, and, moreover, its digestible protein content is much higher than hay. At this time of the year a protein deficiency is probably the most important limiting factor in sheep husbandry (Underwood and Millington, 1947).

Oat grain has the advantage over wheat in that, due to its physical condition, it is more suited to bulk storage over long periods than wheat. Whereas wheat has to be regularly turned over and aerated when in storage for long periods, oat grain can be left for years. It is also less liable to weevil attacks than is wheat. Disadvantages experienced with oats are that they generally shed their grain more readily than wheat and also they are liable to lodging under unfavourable seasonable conditions.

SOIL PREPARATION.

Although oats may do better than wheat with less careful soil preparation, nevertheless, not considering all the other factors associated with crop growth, the better the soil preparation the better the crop. Normally, oat crops, which are intended to be cut for hay or harvested for grain, would probably be sown on fallow, either a long winter fallow or a short autumn fallow. When sown for early green feed the more common practice is to sow them on the previous year's wheat stubble following upon the first appreciable autumn rains. The latter practice allows of early sowing on a fairly good seed bed with a reasonable degree of weed control and probably disc implements would be most suitable for this purpose.

The purpose for which the crop is grown will to a large extent determine the seeding rate, but generally 40 lb. per acre is recommended when the crop is to be grazed right out. When recovery is desired, this rate may be increased to advan-

tage up to 60 or 70 lb. per acre. The actual seeding rate will, however, vary with the purpose of the crop, time of sowing, district, and the stooling habit of the particular variety sown. When sown as a cover crop in the establishing of pastures, 20 lb. of seed is recommended.

With regard to fertiliser requirements, if sown on fallow, the usual rates as used for wheat should be adopted. When planted on stubble land and superphosphate supplies are limited, the normal rate of application may be decreased rather than limit the application at heavier rates to only portion of the area. However, having regard to previous applications, it is not recommended that the rate be less than 40 lb. per acre, particularly for light soil types. Recent experiments with oats indicate that small quantities of minor elements may be necessary to ensure maximum yields on some types of light soils.

The ideal sample for seeding is a well threshed and well cleaned plump grain and the seed should be dusted with one of the proprietary mercurial dusts for the prevention of smut.

VARIETIES.

The selection of suitable varieties is all important. In this connection the maturity and the purpose for which the crop is intended to be used are of first consideration, having regard to the climatic conditions under which it is to be grown. Like wheat, the number of varieties should be limited to, at the most, three. In many instances one variety of oats will be found sufficient. To assist in this connection the wheatbelt is divided into three maturity zones based on annual rainfall. The Road Boards in each zone are—

Zone 1—*Early*	*Zone* 2—*Midseason*	*Zone* 3.—*Late*
(Under 14 inch)	(14-18 inch)	(18-20 inch and above)
Mullewa	Northampton	Greenough
Morawa	Upper Chapman	Irwin
Perenjori	Geraldton	Moora
Dalwallinu	Mingenew	Victoria Plains
Dowerin	Three Springs	Toodyay
Wyalkatchem	Goomalling	York
Koorda	Carnamah	Brookton
Mt. Marshall	Wongan-Ballidu	Cuballing
Mukinbudin	Northam	Narrogin
Westonia	Meckering	Wagin
Nungarin	Corrigin	Katanning
Merredin	Kulin	Broomehill
Kellerberrin	Quairading	Tambellup
Kununoppin	Wickepin	Woodanilling
Bruce Rock	Dumbleyung	Esperance
Narembeen	Kent	(Southern 1/3)
Kondinin	Beverley	
Lake Grace	Pingelly	
Yilgarn	Gnowangerup	
Dundas		
Esperance		
(Northern 2/3)		

Under normal conditions grazing crops will be planted late April or early May. When intended for hay or grain the later maturing varieties will be planted during the first half of May and the early and very early maturing varieties

during the latter half of that month and extending into June. Too early sowing of the early maturing varieties produces a rank tall crop with a greater tendency to lodging.

The following is a table of the varieties now recommended by the Department of Agriculture as a result of the experimental and selection work at the Agricultural Research Stations and elsewhere. The factors for which improvement has been effected are grazing ability, yield and straw strength.

Zone 1	*Zone* 2	*Zone* 3
Dale (late midseason)	Algerian (late)	Algerian (late)
Guyra (midseason)	Fulghum (grazing only)	Fulghum (grazing only)
Ballidu (early)	Guyra (midseason)	Guyra (midseason)
Wongan (very early)	Dale (midseason)	Dale (midseason)
	Ballidu (early)	Ballidu (early)
	Wongan (very early)	Wongan (very early)

A seeding calendar for recommended varieties is also included.

Annual Rainfall.	April.	May.		June.
	3rd–4th week.	1st–2nd week.	3rd–4th week.	1st–2nd week.
Below 14 inches	Dale	Ballidu .... Guyra	Ballidu .... Wongan	Wongan
14 inches–18 inches	Algerian	Dale .... Guyra	Ballidu	Wongan
Over 18 inches	Algerian	Algerian .... Dale	Guyra .... Ballidu	Wongan

A crop of Ballidu oats on the Wongan Hills Research Station. Part of the crop has been cut for hay and the remainder left to mature grain.

OAT VARIETIES.

Two of the more important disadvantages of oat cultivation are that the crops tend to lodge badly, particularly following adverse weather conditions, and also that they tend to shed their grain more easily than wheat. With these two points in mind plant breeders have aimed at producing high yielding varieties of oats

with straw strength and non-shedding characteristics. From a cross between Mulga and Burts Early made at the Wongan Hills Research Station three varieties were selected, Dale, Ballidu and Wongan. The ability to withstand unfavourable weather, the straw strength, and yielding ability of these varieties represent a notable achievement. They are suitable for grain and hay and also for early green grazing and recovery and with their differing maturities cover the range of the planting season. For many years the introduced varieties Algerian, Burts Early, Mulga and Guyra were the principal oat varieties cultivated. With the exception of Algerian these are now being largely replaced with the more recent productions. The acreage sown to oats for all purposes of the principle varieties during the past three seasons is as follows:—

ACREAGE SOWN TO MAIN VARIETIES OF OATS FOR ALL PURPOSES.

1945/46.		1946/47.		1947/48.	
Variety.	Acreage.	Variety.	Acreage.	Variety.	Acreage.
Mulga .... (1)	126,136	Wongan .... (3)	130,590	Ballidu .... (5)	201,081
Guyra .... (2)	117,549	Algerian .... (4)	127,812	Wongan .... (1)	150,836
Wongan .... (3)	114,902	Fulghum .... (5)	117,089	Algerian .... (2)	130,500
Algerian .... (4)	105,867	Guyra .... (2)	111,094	Fulghum .... (3)	114,162
Fulghum .... (5)	97,347	Ballidu .... (6)	104,169	Guyra .... (4)	101,585
Ballidu .... (6)	40,691	Mulga .... (1)	97,404	Mulga .... (6)	79,207
Burt's Early (7)	39,166	Burts Early (7)	33,806	Palestine .... (8)	31,606
Palestine .... (8)	21,231	Palestine .... (8)	29,296	Burts Early (7)	28,734
O.K. .... (9)	6,933	Dale.... ....(10)	9,790	Dale.... .... (9)	16,059
Dale ....(10)	3,884	O.K. .... (9)	4,888	O.K. ....(10)	4,454
Other Varieties	64,473	Other Varieties	19,346	Other Varieties	20,553
Total area sown to all Varieties	738,179	....	785,284	....	878,777

Figures in parentheses indicate position held by variety in previous year.

Oats are classified according to maturity as follows:—

Very early maturing.—Flowering four or more days earlier than Mulga.

Early maturing.—Three days earlier to six days later than Mulga.

Midseason maturing.—Seven to 14 days later than Mulga.

Late maturing.—15 or more day later than Mulga.

The following are short descriptions of the recommended varieties which are at present being produced as pedigree seed:—

Late Maturing.

Algerian.—This variety is cultivated chiefly in the Great Southern areas of the wheat belt, where it is a useful general purpose variety. It is also used extensively for oatmeal manufacture.

Midseason Maturing.

Guyra.—The principal midseason variety, Guyra is notable chiefly for its plump grain. Although a popular hay variety the straw tends to be very coarse under favourable conditions of growth, and lodging frequently occurs where crops

are left for grain. Guyra is an indifferent variety for grazing and recovery since the early growth is relatively sparse and the grain yields subsequent to grazing, only fair.

Fulghum.—This is not a good general purpose variety as the straw strength is very poor. Fulghum is used principally for grazing and recovery since the notable length of its leafy growth phase prior to "shooting" enables it to be grazed later in the season than other midseason varieties. As a grazing oat the initial growth is not as vigorous as that of Dale but it is, however, very suitable for late winter or early spring feed.

The grain of Fulghum is suitable for oatmeal manufacture.

Dale.—This has given satisfactory results as a general purpose variety under a wide range of conditions. It is markedly superior to other midseason varieties in respect to straw strength and for early grazing.

Early Maturing.

Ballidu.—This variety has demonstrated its general superiority to Mulga in trials on Research Stations and is proving satisfactory on farmers' holdings. The straw strength and grain yields are outstanding whilst its vigorous, leafy early growth and satisfactory recovery make it suitable for grazing and recovery.

Very Early Maturing.

Wongan.—This is notable for its vigorous early growth and strong straw. It is satisfactory as a hay variety although it is often rather short strawed. As a grain variety, it stands well but tends to shed if left unharvested after it has matured.

The vigorous early growth makes Wongan a suitable variety for early winter feed, but it cannot be grazed as late in the season as Ballidu and the midseason varieties if recovery for grain is desired.

GRAZING.

A comprehenisve discussion on this subject has appeared in a previous publication (Utilisation of Cereals for Green Fodder, H. G. Cariss Journal Dept. of Agriculture W.A. Vol. XXII June 1945). It is of interest however to repeat the conclusions arrived at in that article, namely—

1. Oats should not be grazed beyond the date where the critical change in growth occurs. This critical change occurs when the plant growth changes from the vegetative or grassy to the reproductive or stemmy.
2. When feeding off the crop it is essential that each grazing should occupy only a short period with a large flock of sheep to prevent selective grazing.
3. Sheep should not be turned into the paddock when it is in a very wet condition, as pugging of the soil may result with a detrimental effect on plant recovery.
4. Crops intended for grain should not be grazed unless absolutely necessary, but in the event of such necessity arising then grazing must be rapid and over a very short period to permit of the maximum period for recovery.

OAT VARIETY TRIALS.

Each year oat variety trials are conducted on the wheatbelt Research Stations with the object of determining the most suitable varieties which can be recommended for planting under Western Australian conditions.

TABLE 2.

OAT GRAIN TRIALS, 1948—WHEATBELT RESEARCH STATIONS

Variety.	Maturity.	Grain Yield.	Per cent. of Control.	
			1948	Average.
WONGAN HILLS RESEARCH STATION—		bus. lbs.	%	%
Late Planted Trial :				
Ballidu	Early	23 0	134	142 (8)
Guyra	Midseason	17 11	100	100
Wongan	Very Early	18 35	109	113 (6)
Early Planted Trial :				
Algerian	Late	20 3	105	112 (8)
Guyra	Midseason	18 35	100	100
Dale	Midseason	20 8	107	114 (8)
MERREDIN RESEARCH STATION—				
Late Planted Trial :				
Ballidu	Early	15 37	442	136 (8)
Guyra	Midseason	3 24	100	100
Wongan	Very Early	14 21	421	123 (8)
SALMON GUMS RESEARCH STATION—				
Late Planted Trial :				
Ballidu	Early	12 14	91	100 (7)
Guyra	Midseason	13 20	100	100
Wongan	Very Early	10 14	76	92 (6)

Number of trials indicated in parenthesis.

These trials are sown on a three plot system which enables each variety to be harvested as it matures and reduces the possibility of variation in yields due to the earlier maturing varieties shedding before the later varieties are ready for harvesting.

SEASONAL CONDITIONS.

Seasonal conditions throughout the wheatbelt varied considerably during 1948, and the following is a brief summary of the conditions experienced at each of the Research Stations:—

Avondale.—Very little rain was recorded before the month of June and consequently seeding operations were much later than usual. Despite the lateness of the opening rains 1,183 points were recorded for the growing period, which compares favourably with the average rainfall. There were heavy falls registered during the months of June, July, August and September with lighter falls in October and November. Most crops finished off reasonably well.

Table 1.

Station.	Year.	Jan.	Feb.	Mar.	Apl.	Growing Period Rainfall.							Nov.	Dec.	Annual Total.
						May.	June.	July.	Aug.	Sept.	Oct.	Total.			
Avondale	1948	0	0	71	35	6	385	214	246	249	83	1,183	63	9	1,361
Average	22 years	23	34	101	79	217	337	308	240	106	80	1,288	53	31	1,609
Chapman	1948	0	0	34	105	0	257	220	198	97	15	787	46	0	972
Average	43 years	26	38	66	75	230	425	389	262	144	88	1,538	39	25	1,807
Merredin	1948	28	11	56	161	4	189	204	192	102	38	729	33	16	1,034
Average	37 years	42	53	95	90	136	196	185	153	81	75	826	42	55	1,203
Salmon Gums	1948	0	417	30	120	9	152	137	112	51	105	566	141	9	1,283
Average	23 years	80	87	139	93	121	151	142	146	91	112	763	91	76	1,329
Wongan Hills	1948	1	5	140	187	0	175	290	370	104	19	958	83	8	1,382
Average	23 years	33	45	96	96	187	270	261	208	91	70	1,087	45	40	1,442

Chapman.—Rainfall throughout the year was very light and well below the average each month, only 787 points were recorded for the growing period, compared with an average of 1,542 points. No rain was recorded in May and only about half the average rainfall registered for June.

Merredin.—Following upon a good heavy rain at the end of April which allowed the fallow to be worked into good condition, no appreciable rains were recorded until the 6th June. Comparatively dry conditions were experienced during the remainder of the growing period and these, together with the hot dry winds experienced in September and October caused severe setbacks to the crops. Good falls were recorded late in September, but they were too late to be of much benefit to the crops generally.

Salmon Gums.—Early rains recorded in February enabled the fallow to be worked into good condition. Following upon a good fall in April no appreciable rains were experienced until early June. Good falls were recorded in June, July and August and later falls in October resulted in quite good yields being obtained.

Wongan Hills.—Following upon the good rainfall registered in April no rain at all was recorded for the month of May; however, rainfall for the remainder of the growing period was satisfactory except perhaps for October, when only 19 points were recorded, and crops generally made good growth.

Details of the rainfall recorded at each of the Research Stations during 1948 are given in Table No. 1 and results of the oat variety trials carried out in 1948 are tabulated in Table No. 2.

Oat grazing and recovery trials are also conducted at the Merredin and Chapman Research Stations, but during the past two years the seasonal conditions have been such that following upon grazing the trials have failed to recover, and therefore results were not available. The practice in these trials is to cut representative portions of each plot to ascertain the green feed value as soon as the average of the varieties reaches 6ins. in height. The plots are then heavily and speedily grazed to a uniform sward by sheep. The plots are subject to further sampling and grazing if seasonal conditions permit and finally they are left to mature grain.

ACKNOWLEDGMENTS.

This opportunity is taken of thanking the farm managers and staff of the Research Stations for their assistance in the above trials.

REFERENCES.

Thomas, I., Millington, A. J. and Cariss, H. G.: "The Utilization of Cereals in Western Australia." Journ. Agric., W.A. Vol. XXI, 2nd Series, No. 3, pp. 206-226.

Cariss, H. G.: "The Utilization of Cereals for Green Fodder." Journ. Agric. W.A. Vol. XXII, 2nd Series, No. 2, pp. 154-162.

Underwood, E. J. and Millington, A. J.: "Further Studies with Cereal Hays in W.A." Journ. Agric., W.A. Vol. XXIV, 2nd Series, No. 4, pp. 250-259.

Underwood, E. J. and Moir, R. J.: "Studies in Cereal Hay Production in W.A." Journ. Agric., W.A. Vol. XXI., 2nd Series, No. 1, pp. 41-45.

AN EXPERIENCE IN ARGENTINE ANT CONTROL.

By P. N. Forte, Assistant Entomologist.

INTRODUCTION.

SINCE the discovery of the Argentine ant in Western Australia, its control has been a foremost problem with the Entomological Branch of the Department of Agriculture.

The first avenue explored was control by baiting, but with the advent of D.D.T. as an insecticide it was tried as a possible control for this pest. Correctly used, D.D.T. proved to be as effective and spectacular in controlling Argentine ants as it has been with such insects as flies and mosquitoes.

The use of D.D.T. was then recommended by this Department for ant control, and good reports followed when it was used according to departmental directions.

A PERSONAL EXPERIENCE.

In September, 1947, the author had an opportunity of applying the departmental recommendations under careful supervision when his own block, in one of the suburbs of Perth, became invaded by Argentine ants.

The invasion was not discovered until September, 1947, when the back half of the yard was cleared of grass to prevent summer fires. It was then found that the Argentine ant had gained a firm hold on most of this area (about one-third of the quarter-acre block) and that they had supplanted the native ants which were previously plentiful.

A survey of the blocks in the vicinity showed that those on either side were also being invaded by Argentine ants, and that the blocks behind had evidently been invaded for some time. The householders concerned were all approached and advised of the best measures to adopt to control the pest.

I had always believed that it should be possible to isolate not only a house but the whole building block in an infested area from the Argentine ant, by the use of a D.D.T. sprayed strip, and therefore decided to try the method out in this instance.

Method of Attack.

In the first place, all shrubs, plants and hedges were pruned back so that they did not touch the fence anywhere and no branches of trees were allowed to touch others in adjacent blocks. All rubbish, dry leaves, etc., were cleaned up and burnt. Then with a knapsack spray a D.D.T. emulsion at 2 per cent. strength was sprayed in a band approximately 8in. up the picket fence and 4in. on the ground out from the pickets. This was applied to the two side fences and the back fence, all being of the picket type. It was not necessary to spray the front fence as the infestation had not reached this point.

Interesting Observations.

The result was immediate and spectacular. All ant trails using the lower part of the fence disappeared, both those coming straight through and those using the fence itself. For weeks after, this state of affairs persisted.

Characteristic trails of the Argentine Ant on a tree trunk.
(From U.S. Dept. Agric.)

Eradication within the Area.

Attention was then turned to the Argentine ants present inside the block. This infestation consisted of nests situated in bare sand and some in the lawn and gardens. The trails and nest holes were carefully sprayed with a 2 per cent. D.D.T. emulsion, and the results were very interesting. Those worker ants sprayed

were killed more or less at once and the activity from the nests ceased. Observations a few hours later showed that numbers of winged male and female ants had emerged and were lying struggling within about a foot of the nest entrance.

Subsequently, a number of worker ants ventured out and were found dying in a similar way. Without disturbing the sprayed surfaces around the nest hole, observations were made each morning on the following days. At these times worker ants could be seen struggling on the ground near the nest entrance and were found dead some time later. It took several days in most cases before activity from the nests ceased altogether, and when this occurred the nest was dug up and the ants were found to have been completely killed out.

The longest period taken for one nest to be cleaned up with one spraying was nine days. The same good results were obtained on lawns, and therefore I was able to eradicate the ants from the block.

Re-infestations.

A careful watch was kept and some weeks elapsed before a thin trail of worker ants appeared between two pickets and stretched 30ft. into the block to raid the nest of a native ant species. This occurred overnight and following a shower of rain. The trail was quickly removed with a 2 per cent. D.D.T. emulsion spray.

It was thought that possibly the effect of the D.D.T. was wearing off, and so the band around the fence was again sprayed. Since then an occasional trail has penetrated the block, but observations about once a week have revealed these and they have been dealt with immediately.

During the winter of 1948 little ant activity was evident, and it was not until early summer that it was necessary to respray the boundary. At this time when the weather warmed up and the conditions were humid, the Argentine ants were very active and it was necessary to deal with a number of trails and several nests, but these were easily removed by the method described.

Frequency of Application.

The fence line has since been sprayed twice—making three times this summer. The amount used at each spraying was approximately one-third gallon of 20 per cent. D.D.T. emulsion, which would cost approximately 10s.

Watch Points of Contact.

The places which must be watched are mainly points of contact with the fence and inside the block. Many of these occur subsequent to the spraying Shrubs grow and touch the fence and must be pruned back again; hedges do likewise. Sticks or branches may fall and make a bridge from above the D.D.T. line on the fence to the ground inside the block. In the case of permanent structures, such as lattices touching the fence, the area of contact must also be sprayed with D.D.T.

Isolating the House Itself.

It has also been demonstrated to my satisfaction that a house on an infested block can be isolated with a D.D.T. barrier and so kept free from ants. Again the precautions necessary are to see that all shrubs, etc., are pruned away, so that they do not touch the house, and that all other points of contact, e.g., lattices, are sprayed with D.D.T. Then a similar strip of D.D.T. is sprayed around the foundations as that described for use around the fence.

Where gardens or lawns run up to a wall, it is sometimes difficult to detect ant activity, and one person overcame this by running a 4in. cement strip around the junction of the wall and the ground, except where a cement path was already present. This strip was then kept sprayed with 2 per cent. D.D.T., and it was a simple matter to watch for further invasions.

Treatment of Whole Block.

Where it is desired to completely eradicate Argentine ants from a block, it is first necessary to clean up and dispose of by burning or otherwise all rubbish, tins, bricks, etc., which may be lying around. Then everywhere from the house foundations to the fence should be sprayed with 2 per cent. D.D.T. emulsion. The quantity of spray required for a treatment such as this is approximately 20 gallons for a quarter-acre block or two gallons of 20 per cent. D.D.T. emulsion costing approximately £3.

METHODS USED SUCCESSFULLY BY COMMERCIAL PEST EXTERMINATORS.

These recommendations have been used by commercial operators with effective results, and are therefore advised with complete confidence.

Summary.

1. Argentine ants can be cleaned out by the recommended use of D.D.T. sprays.
2. A complete clean up of all rubbish is essential before spraying.
3. All points of contact with the infested area and the area to be kept clean must be sprayed with a 2 per cent. D.D.T. emulsion.
4. Careful pruning of all plants on the boundary, so they do not touch the area to be protected is essential.
5. A certain amount of vigilance and spot spraying subsequently will be necessary.

BLACKLEG IN CATTLE.

C. R. Toop, Acting Chief Veterinary Surgeon.

Blackleg is almost essentially a disease of young cattle usually affecting animals between the age of six and 18 months.

It is characterised by the development of crepitant swellings on the neck, chest, shoulder or hindquarters and sometimes on other parts of the body, and this is accompanied by symptoms of acute illness which in most cases terminates fatally after an interval of 18-36 hours.

It is caused by infection with *Clostridium chauvoei,* a short rod shaped micro-organism or bacillus which occurs in the soil and is believed to gain entrance to the body through abrasions in the skin or mucous membrane of the digestive tract. *Clostridium chauvoei* produces spores which are able to survive in the soil for long periods. Consequently when the infection has become established on a property, outbreaks of the disease may continue to occur for many years.

Although blackleg may occur under a wide variety of conditions it is most frequently observed on moist low lying areas. In Western Australia it is confined to the South-West coastal districts and has not been reported from the drier inland areas.

The disease may be prevented by inoculation with blackleg vaccine which confers upon the treated animals a strong and lasting immunity and is usually sufficient to protect young cattle from infection during the period when they are most susceptible.

MODE OF INFECTION.

It should be recognized that blackleg does not spread directly from animal to animal but results from infection with an organism existing in the soil. The blackleg bacillus (*Clostridium chauvoei*) is always present in the soil of affected properties and so far as is known enters the body through small wounds and punctures in the skin or through abrasions in the mouth or tongue or other portions of the digestive tract.

The carcass of an animal dead of blackleg contains enormous numbers of infective organisms and should it be allowed to decompose and disintegrate in the field gross contamination of the soil will inevitably occur. Such carcasses should, therefore, be promptly destroyed by burning or if this is impracticable by deep burial preceded by a liberal application of quicklime. The organisms are also able to multiply in the soil.

The formation of spores which are very resistant to extremes of temperature and drying enables the infection to persist in the soil for many years so that after the disease has made its appearance on a property recurrent mortalities are likely to take place.

SYMPTOMS.

The disease has a definite age incidence usually affecting young cattle between the age of six and 18 months. It may also be observed on occasions in calves four to six months old but seldom affects animals above the age of two years. In districts where blackleg is prevalent cattle over three years may be regarded as immune.

The onset of the disease is sudden. The earliest symptoms consist of loss of appetite and cessation of rumination together with high fever and rapid respiration. The animal appears dull and depressed, is reluctant to move and lies down frequently. The development of swellings on the shoulder, neck, chest thigh or flank, and sometimes elsewhere on the body is a characteristic feature of the disease and this is usually accompanied by lameness affecting the fore or hind limbs.

The swellings are at first small and tender but rapidly increase in size becoming large and extensive and non-sensitive. Upon pressure a peculiar crackling sound is heard due to the presence of gas beneath the skin which is formed during the growth of the casual organism in the underlying tissues. Similar swellings are sometimes observed on the gums, tongue, and pharynx,

From this stage the condition of the animal rapidly deteriorates and soon it is unable to rise. Death generally occurs from 12-36 hours from the onset of symptoms and is preceded by prostration and muscular tremors.

Treatment offers little prospect of success and is usually not worth attempting.

POST MORTEM APPEARANCES.

Soon after death the carcass becomes tightly distended with gas so that the uppermost limbs may extend straight out from the body and a dark coloured frothy discharge exudes from the mouth, nostrils and anus.

At post mortem the skin overlying the swelling appears dark, dry and parchment-like, and a dark frothy fluid with a sour disagreeable odor escapes when the swelling is incised. The underlying muscles are distended and are brown or black in colour and are infiltrated with blood stained liquid and gas. Apart from the presence of fluid in the abdomen and chest cavity and some congestion of the liver and kidneys no changes of note are observed in the internal organs.

PREVENTION.

Vaccination.—The disease may be prevented by inoculation with blackleg vaccine which provides the only practical and effective means of control. An injection of 5 cc. of this product given beneath the skin either in front of or behind the shoulder, results after an interval of 14 days in the development of a strong immunity which endures for 12-18 months and is therefore capable of protecting young animals from infection during the period when they are most susceptible to the disease.

In localities where the disease has a seasonal incidence young stock should be vaccinated annually at least 14 days in advance of the period when losses are expected to occur. Where the disease occurs irregularly calves should be vaccinated upon reaching the age of four to six months. It should be noted that blackleg vaccine is not a curative and is only of value for the prevention of the disease. When, however, the disease makes its appearance on a property the immediate vaccination of the animals which are still healthy followed by their removal to a fresh paddock for a period of 14 days can be relied upon to check the mortality.

As an additional control measure the carcass of any animal dead of blackleg should be destroyed by burning or by burial to a depth of six feet together with the application of quicklime.

NEW CEREAL VARIETIES IN AUSTRALIA.

I. Thomas—Registrar of Cereal Varieties in Australia.

DURING 1948 three new wheat varieties were submitted for registration. Of these one was sponsored by the Waite Agricultural Research Institute, Adelaide, the other two being produced by the Western Australian Department of Agriculture. Particulars of the new varieties as supplied to the Registrar are as follows—

GLENWARI.

A variety of midseason maturity Glenwari was derived from the cross Nabawa x (Riverina x Hope) made by S. R. Hockley at Adelaide in 1932. Subsequent selection was carried out at the Waite Agricultural Research Institute by I. F. Phipps.

Glenwari possesses straw of medium height that stands well and has a white square shaped slightly tip awned ear which does not shed. The reaction to disease includes resistance to leaf rust, race 34 and its biotype of stem rust, and flag smut. It is of average baking quality and possesses good yielding ability. The Waite Institute states it is capable of outyielding Warigo as a rust resistant wheat grown in more severe districts than is optimum for that variety.

WONGOONDY.

This variety was derived from a cross between Eureka and Bungulla made by E. C. B. Langfield at the Merredin Research Station in 1940. It is an early maturing variety which, under suitable conditions, produces grain approaching premium quality. It is medium tall growing with a strong straw which stands well, and has a white, tip tapering, tip awned ear which does not shed its grain. Wongoondy possesses a strong resistance to flag smut and to race 34 of stem rust, but is susceptible to the biotype.

Yield data from trials on five research stations and two farmers holdings indicate that Wongoondy is a very good yielder over a wide range of soil and climatic conditions.

DOWERIN.

This variety was also produced at the Merredin Research Station by E. C. B. Langfield from a cross between Sword and Kenya made in 1937.

It is of early to midseason maturity and is tall growing with fine straw which shows a tendency to weakness under certain conditions. The ear is white, tapering and partly bearded, yielding grain which is in the upper range of the Western Australian f.a.q. standard. The grain is held well, although threshing is inclined to be somewhat tough.

Dowerin possesses very good resistance to both race 34 of stem rust and its biotype in addition to resistance to flag smut and powdery mildew.

Yield data from three research stations show Dowerin to be favourable in this respect as compared with standard varieties at present under cultivation.

COST OF FEEDING PURE-BRED DAIRY COWS UNDER THE AUSTRALIAN OFFICIAL PURE-BRED HERD RECORDING SCHEME IN WESTERN AUSTRALIA, 1947-8.

M. CULLITY, Superintendent of Dairying.*

In 1924 a report under the above heading was issued from this Department and each year up to and including 1938-39 similar reports were prepared and published.

The object was to record as accurately as possible the wide range of feeding costs incurred by breeders of pure-bred dairy cattle, with a view to assisting in reducing unnecessary expenditure—partly by showing where purchases were unbalanced and by drawing attention to the effectiveness of full use of pasture, conserved fodder both as hay and silage, and farm grown fodder crops.

The pure-bred herds submitted for test are located over a wide area of the South-Western Division, extending 60 miles north of Perth and along the Great Southern Railway line, as well as through the main dairying districts.

The herds are therefore held under a wide range of climatic conditions and it is natural there is considerable variation in the cost of providing feed for producing both milk and butter-fat. As the climatic conditions vary, the type of agriculture also is not constant. Herds are operated under conditions having up to nine months of pasture and also in areas where the principal crop is wheat and the length of the effective pasture season not more than four or five months. It will be understood also that the cost of the various fodders which are produced, vary from farm to farm and in order to ensure that a comparison may be as equitable as possible, the rates adopted are the average wholesale market prices at Perth.

Since the last report published in 1940, the prices of most fodders have increased by relatively large amounts. However, in the rates which have been adopted, it will be seen that there is one noticeable exception. In previous reports, pasture was valued as follows:—

per head per week	.. ..	good green	2s. 6d.
per head per week	.. ..	dry	1s. 6d.

After full consideration, it has been decided to adopt the figure of 1s. 6d. per cow per week as a standard charge, as it is believed that the cost of providing pasture on a farm throughout the year would not exceed this figure. This will have the effect of making the average cost for 1947-48 appear lower than what would have been the cost had the previous rate been maintained or increased.

It is necessary to emphasise that there is no suggestion of a competition in preparing the following tables. To ensure this, the owners' names have been replaced by a herd letter. However any breeder who is anxious for the details of his own herd can procure the information by applying to the Department of Agriculture.

It is possible, owing to the method of collection that minor inaccuracies may be present, but the final result should be comparable between herd and herd and with allowance for the difference due to the valuation of pasture, between year and year.

* Records by B. H. Drakes. Tabulations by A. Goldie.

Table 1 gives the prices of the feeding stuffs which were adopted in the calculations.

Table 1.

PRICES USED IN VALUATING THE FOODSTUFFS CONSUMED DURING THE YEAR ENDED 30th JUNE, 1948.

	£	s.	d.
Chaff (per ton)	8	12	6
Wheat, crushed (per bushel)	0	7	6
Oats, crushed (per bushel)	0	6	0
Bran (per ton)	6	15	2
Pollard (per ton)	6	15	2
Branato (per ton)	6	15	2
Calf meal (per ton)	17	15	0
Sweet Dairy Meal (per ton)	11	12	6
Dairy Food (per ton)	12	17	6
Linseed Meal (per ton)	18	0	0
Meatmeal (per ton)	13	0	0
Meggitts Meal (per ton)	15	11	6
Hay (per ton)	6	0	0
Silage (per ton)	1	0	0
Green Feed (per ton)	1	0	0
Lick (per ton)	16	0	0
Bone Meal (per ton)	11	0	0
Pasture (per head, per week)	0	1	6

The average results which have been obtained for the 16 years—1924 to 1939, and in the most recent year, 1947-48, are set out in the following table.

Table 2.

PURE-BRED COWS UNDER OFFICIAL TEST—AVERAGE RESULTS OVER A PERIOD OF 17 YEARS.

Year ended 30th June.	Average Milk Yield per cow.	Average Butterfat per cow.	Average cost of feed per cow.	Average cost of feed to produce 1 lb. Butterfat.	Average cost of feed to produce 1 gallon Milk.	Average price Butterfat per lb.
	gallons	lbs.	£ s. d.	pence	pence	pence
1924	600	319·50	10 4 10	7·70	4·09	19·5
1925	652	308·59	14 13 2	10·77	6·15	17·5
1926	624	312·01	14 14 7	11·15	5·66	19·0
1927	602	290·72	14 10 5	12·00	5·79	19·0
1928	592	280·56	15 11 4	13·34	6·34	19·5
1929	629	295·10	15 1 0	12·24	5·74	20·0
1930	636	294·98	14 10 3	12·74	5·10	19·5
1931	643	301·60	9 14 7	7·74	3·64	16·0
1932	696	318·96	10 18 3	8·21	3·76	14·0
1933	664	308·60	9 2 3	7·08	3·29	11·0
1934	720	333·70	10 2 6	7·28	3·37	10·0
1935	682	326·61	9 18 0	7·34	3·49	12·5
1936	681	320·14	8 14 7	6·54	3·08	12·5
1937	685	309·31	11 5 1	8·73	3·94	14·5
1938	664	306·99	10 19 7	8·58	3·97	15·0
1939	681	310·13	10 13 7	8·26	3·76	16·0
1948	653	311·20	13 13 3	10·53	5·02	27·0

It will be noted that there has been an increase in cost compared to 1939, but this is not as great as would be expected, even when allowance is made for a reduction in pasture valuation, which probably would amount to 1d. per gallon or 2½d. per lb of butter-fat.

There is only a very slight increase in the yield of butter-fat and a small decrease in the average yield of milk.

The average cost of feeding to produce 1lb. butter-fat is assessed as 10.53d. while the cost for one gallon of milk is 5.02d.

BREEDS.

Previous reports provide a comparison between the efficiency of the breeds as economical producers of milk and butter-fat. This data has again been tabulated and the results for the three breeds officially tested in this State, the Jersey, the Guernsey and the Australian Illawarra Shorthorn, are shown in table 3.

TABLE 3.

BREEDS COMPARED AS PRODUCERS OF MILK AND BUTTERFAT.

Breed.	Average Milk per cow during 9 months.	Average Test	Average Butterfat per cow during 9 months.	Average cost of feed per cow.	Average cost of feed to produce 1 gallon Milk.	Average cost of feed to produce 1 lb. Butterfat.
	lbs.	%	lbs.	£ s. d.	pence	pence
A.I.S. (12 herds)	7,001	3·85	269·83	16 4 6	5·55	14·80
Guernsey (8 herds)	6,340	5·12	324·75	13 19 11	5·03	10·34
Jersey (20 herds)	6,262	5·23	337·81	11 8 5	4·37	8·11

It will be noted that the Jersey breed on this occasion has the lowest cost of feed for producing both milk and butter-fat and that the Australian Illawarra Shorthorn has the highest cost for both.

This result is contrary to that obtained in previous years when the Jersey was the most successful in achieving the lowest cost for butter-fat and the Australian Illawarra Shorthorn had the distinction of the lowest cost for producing a gallon of milk. In the present table the Guernsey breed occupies the intermediate position between the Jersey and the Australian Illawarra Shorthorn. The explanation of the failure of the latter breed is probably in the relatively low average yield per cow achieved during the season.

It would normally be expected that the Jersey and Guernsey, being what are known as "butter-fat breeds" would be more economical producers of butter-fat but in considering the relative suitability of breeds of dairy cattle other factors must receive attention. The capacity for producing large quantities of milk, which is a characteristic of the Australian Illawarra Shorthorn makes it of special value in areas where milk is produced for consumption as such and is sold on a gallonage basis.

This breed also has a special value, even where butter-fat is sold by virtue of the additional quantity of skim milk which is available for feeding to pigs.

In addition, on larger properties where the owner has sufficient grazing to rear steers, the added return which may be obtained from this activity may more than balance the difference between the output of butter-fat of the shorthorn and the "butter-fat" breeds.

This comment should not be construed to mean that on small properties capable of carrying the dairy herd only, that the value of cull cows of the Shorthorn breed will outweigh the advantage of production of the butter-fat breeds. It is only in exceptional cases that such would be the case.

No attempt is being made here to recommend any breed, but the results are submitted for study by farmers.

"WET" VERSUS "DRY" AREAS.

The relative cost of producing milk or butter-fat in the heavy rainfall, or dairying, districts, compared with the drier areas of the State referred to earlier, is shown in table 4.

Table 4.

COST IN LIGHT RAINFALL AREAS COMPARED WITH THE SOUTH-WEST.

	Average Production per Cow.		Cost of Feed for—	
	Milk.	Butterfat.	1 gallon Milk.	1 lb. Butter-fat.
	lbs.	lbs.	pence	pence
Dry areas (10 herds)	6,767	346·59	5·59	11·60
Wet areas (30 herds)	6,458	299·56	4·69	10·11

It will be seen that the difference in the cost is not as great as would be expected.

It must be pointed out, however, that the difference is considerably less than the analyses of costs in a similar way for the previous years. This may be due to the fact that on this occasion the average yield of the herds in the dry areas has proved considerably higher than those in the heavy rainfall districts.

Table 5 places the herds in order of merit as profitable producers of butter-fat.

The average cost of producing 1lb. of butter-fat was 10.53d. Seventeen of the forty herds had a higher figure and it appears that the cost of producing 1lb. of butter-fat in many herds is too great. However this may not be a justifiable conclusion in view of the fact that 23 of the 40 herds showed a profit over the cost of feeding of more than £24 15s 9d. which was the average for the 40 herds. Of these three had average costs per lb. of butter-fat greater that the average, and achieved the greater profit because of their high average butter-fat yield.

On the other hand, of the seventeen herds which had a profit over the cost of feeding of less than the average of £24 15s. 9d. three had average costs per lb. of butter-fat lower than 10.53d. Low average production per cow was responsible for the smaller profit. It therefore follows that high cost per lb. butter-fat does not necessarily limit profit as it may be offset by high yields. Again, low costs of feeding may not always be an advantage if they are the result of a low plane of feeding leading to low yields.

TABLE 5.

HERDS IN ORDER OF MERIT AS PROFITABLE BUTTER-FAT PRODUCERS.

Place.	Herd.	District (W = Wet) (D = Dry)	Breed.	Average Butter-fat per Cow for 9 months.	Available Skim Milk per Cow.	Value of Butter-fat per Cow at 2s. 3d. lb.	Value of Skim Milk per Cow at 2d. gal.	Gross Return from Butter-fat and Skim Milk per Cow.	Cost of Feed per Cow for 9 months.	Profit per Cow.	Cost of Feed to produce 1 lb. Butter-fat.
						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.
1	AO	D	Jersey	471·68	5,440	53 2 0	4 10 8	57 12 8	14 18 0	42 14 8	7·57
2	AR	W	Jersey	453·59	5,600	51 1 6	4 13 4	55 14 10	13 0 6	42 14 4	6·87
3	AH	W	Jersey	454·11	5,560	51 1 6	4 12 8	55 14 2	13 2 6	42 11 8	7·93
4	E	W	Jersey	423·62	5,390	47 14 0	4 9 10	52 3 10	10 7 6	41 16 4	5·87
5	N	D	Guernsey....	386·28	5,470	43 8 6	4 11 2	47 19 8	10 2 6	37 17 2	6·29
6	AF	W	Jersey	390·39	4,540	43 17 6	3 15 8	47 13 2	10 13 6	36 19 8	6·57
7	O	W	A.I.S.	385·62	7,170	43 8 6	5 19 6	49 8 0	12 13 0	36 15 0	7·89
8	C	D	Jersey	424·85	4,740	47 16 3	3 19 0	51 15 3	15 8 0	35 17 3	8·69
9	V	W	Jersey	322·84	3,570	36 6 9	2 19 6	39 6 3	5 6 6	33 19 9	3·97
10	Y	W	Jersey	356·41	3,730	40 1 0	3 2 2	43 3 2	10 1 6	33 1 8	6·79
11	M	D	Guernsey....	432·18	5,440	48 12 0	4 10 8	53 2 8	21 8 6	31 14 2	11·90
12	F	W	Jersey	325·26	3,130	36 11 3	2 12 2	39 3 5	7 14 6	31 8 11	5·70
13	K	W	Guernsey....	335·61	4,250	37 13 9	3 10 6	41 4 3	10 3 6	31 0 9	7·26
14	H	W	Jersey	295·96	3,330	33 6 0	2 15 6	36 1 6	7 6 6	28 15 0	5·94
15	W	W	Jersey	321·53	3,910	36 4 6	3 5 2	39 9 8	10 15 6	28 14 2	8·34
16	AJ	W	Jersey	255·66	2,600	28 16 0	2 3 4	30 19 4	2 18 6	28 10 0	2·74
17	AC	W	A.I.S.	292·51	5,480	32 17 0	4 11 4	37 8 4	9 13 6	27 14 10	7·92
18	R	W	Guernsey....	343·26	3,870	38 11 9	3 4 6	41 16 3	14 5 6	27 12 9	9·98
19	AQ	W	Jersey	308·28	3,440	34 13 0	2 17 4	37 10 4	10 8 6	27 1 10	8·12
20	B	W	A.I.S.	274·01	4,440	30 16 6	3 14 0	34 10 6	7 14 6	26 16 0	6·75
21	AN	W	Jersey	329·49	3,720	37 0 3	3 2 0	40 2 3	14 11 0	25 11 3	10·61
22	AG	W	Guernsey....	249·47	2,710	28 0 3	2 5 2	30 5 5	5 3 6	25 1 11	5·00
23	Z	D	A.I.S.	305·80	5,260	34 8 6	4 7 8	38 16 2	13 18 6	24 17 8	10·92
24	S	W	Jersey	305·73	3,330	34 8 6	2 15 6	37 4 0	12 6 6	24 14 6	9·66
25	U	W	Guernsey....	368·28	4,340	41 8 0	3 12 4	45 0 4	20 7 6	24 12 10	13·29
26	AD	W	A.I.S.	303·53	4,850	34 1 9	4 0 10	38 2 7	14 12 6	23 10 1	11·54
27	G	D	Jersey	353·12	4,120	39 14 3	3 8 8	43 2 11	20 6 0	22 16 11	13·80
28	Q	W	Jersey	297·07	3,110	33 8 3	2 11 10	36 0 1	13 8 6	22 11 7	10·85
29	L	D	Jersey	339·03	3,620	38 2 9	3 0 4	41 3 1	18 18 6	22 4 7	13·40

30	AB	W	Jersey	258·57	3,030	29	2	9	2	10	6	31	13	3	9	18	6	21	14	9	9·19
31	I	W	A.I.S.	251·78	4,270	28	4	9	3	11	2	31	15	11	10	15	6	21	0	5	10·26
32	AI	W	A.I.S.	296·83	5,530	33	8	3	4	12	2	38	0	5	17	14	6	20	5	11	14·32
33	P	D	A.I.S.	194·98	3,000	21	18	9	2	10	0	24	8	9	6	1	0	18	7	9	7·44
34	T	W	Guernsey....	258·50	3,020	29	2	9	2	10	4	31	13	1	15	0	6	16	12	7	13·92
35	AE	W	Guernsey....	238·68	2,360	26	17	9	1	19	4	28	17	1	13	1	0	15	16	1	12·58
36	A	W	A.I.S.	210·35	4,030	23	12	6	3	7	2	26	19	8	11	9	0	15	10	8	13·08
37	AA	W	A.I.S.	279·18	4,470	31	7	9	3	14	6	35	2	3	20	6	0	14	16	3	12·74
38	X	W	A.I.S.	255·06	4,260	28	13	9	3	11	0	32	4	9	18	3	6	14	1	3	17·10
39	J	W	Jersey	211·86	1,900	23	17	0	1	11	8	25	8	8	13	1	0	12	7	8	14·71
40	AK	D	A.I.S.	210·23	3,250	23	12	6	2	14	2	26	6	8	25	2	6	1	4	2	28·71
Average				311·20	4,140	35	0	0	3	9	0	38	9	0	13	13	3	24	15	9	10·53

The leading herd owned by Mr. M. B. Stott of Wickepin, showed a net profit of £42 14s. 8d. over feeding costs, the average per pound of butter-fat being 7.57d.

An example of uneconomic feeding in shown in the herd "AK" which, with an average yield of 210 lb. of butter-fat had an average cost of feeding of £25 2s. 6d., allowing a profit of £1 4s. 2d. The cost of producing 1lb. of butter-fat in this herd was 28.17d. In this case it is obvious that profit was sacrificed by injudicious feeding.

In the comment to Table 3, reference was made to the value of the "butter-fat breeds" in the economical production of butter-fat and therefore the fact that fifteen of the first sixteen herds were of Jersey or Guernsey breed was not more than would be expected.

The relative value of the breeds for producing milk, however is referred to later in the report when the value of the Australian Illawarra Shorthorn breed is emphasised.

The table also indicates the location of the various herds either as being in the "dry" or the "wet" areas. From a study of the results other breeders may be able to gain some knowledge as to the conditions in the various areas.

A general statement however, can be made, that it does not matter where the herd is located as long as efficient feeding is carried out. In such circumstances both high yields and low costs can be achieved.

In table 6 the same herds are arranged in order of merit in respect to the profit which can be made as milk producers.

The two leading herds are of the Australian Illawarra Shorthorn breed and are owned by Mr. B. W. Prowse and Mr. J. Marston respectively. Both are in the dairying areas and are grazed on good quality pasture. Not only were profits over the cost of feed high, £69 17s. and £57 3s. 2d. respectively, but the cost of feeding per gallon of milk was low, 3.33d. and 2.89d. respectively.

Owing to high yields compared to the Shorthorn herds the next five places in order of merit are occupied by a Guernsey and four Jersey herds. However, examining Table 5 in conjunction with Table 6 it will be seen that the Shorthorn breed appears in a more favourable light as producers of milk.

The publication of these figures is intended to help breeders in a study of feeding methods and to focus attention on the farm grown fodder as the cheapest and best general source of supplies. It is obvious from a study of the feeds used that too great a proportion of the herds are maintained on purchased fodder. While this may be justified where force of circumstances necessitates the keeping of a larger herd than farm sources will maintain; it generally reacts against the breeder by developing the thought in his neighbours and his customers that his cows are attuned to high concentrate feeding and may be uneconomical producers on a commercial farm.

Table 6.

HERDS IN ORDER OF MERIT AS PROFITABLE MILK PRODUCERS, 1947–48.

Place.	Herd.	Breed.	Average Milk per cow for 9 months.	Value of Whole Milk at 1s. 8d. per gallon.	Cost of Feed per cow for 9 months.	Profit per cow.	Cost of Feed to produce 1 gallon Milk.
			lb.	£ s. d.	£ s. d.	£ s. d.	d.
1	O	A.I.S.	9,907	82 10 0	12 13 0	69 17 0	3·33
2	AC	A.I.S.	8,024	66 16 8	9 13 6	57 3 2	2·89
3	N	Guernsey	8,010	66 15 0	10 2 6	56 12 6	3·03
4	E	Jersey	7,920	66 0 0	10 7 6	55 12 6	3·14
5	AR	Jersey	8,151	67 18 4	13 0 6	54 17 10	3·83
6	AH	Jersey	8,112	67 11 8	13 2 6	54 9 2	3·88
7	AO	Jersey	7,976	66 8 4	14 18 0	51 10 0	4·48
8	Z	A.I.S.	7,777	64 15 0	13 18 6	50 16 6	4·44
9	AI	A.I.S.	8,075	67 5 0	17 14 6	49 10 6	5·27
10	B	A.I.S.	6,868	57 3 4	7 14 6	49 8 10	2·70
11	AF	Jersey	6,975	58 1 8	10 13 6	47 8 2	3·67
12	AD	A.I.S.	7,320	61 0 0	14 12 6	46 7 6	4·79
13	K	Guernsey	6,651	55 8 4	10 3 6	45 4 10	3·67
14	M	Guernsey	7,974	66 8 4	21 8 6	44 19 10	6·45
15	C	Jersey	7,191	59 18 4	15 8 0	44 10 4	5·14
16	I	A.I.S.	6,672	55 11 8	10 15 6	44 6 2	3·87
17	V	Jersey	5,895	49 1 8	5 6 6	43 15 2	2·16
18	A	A.I.S.	6,419	53 8 4	11 9 0	41 19 4	4·29
19	W	Jersey	6,273	52 5 0	10 15 6	41 9 6	4·12
20	Y	Jersey	6,075	50 11 8	10 1 6	40 10 2	3·98
21	H	Jersey	5,631	46 18 4	7 6 6	39 11 10	3·12
22	P	A.I.S.	5,261	43 16 8	6 1 0	37 15 8	2·76
23	R	Guernsey	6,237	51 18 4	14 5 6	37 12 10	5·49
24	F	Jersey	5,418	45 1 8	7 14 6	37 7 2	3·42
25	X	A.I.S.	6,665	55 10 0	18 3 6	37 6 6	6·54
26	AA	A.I.S.	6,901	57 10 0	20 6 0	37 4 0	7·06
27	AJ	Jersey	4,824	40 3 4	2 18 6	37 4 10	1·46
28	AQ	Jersey	5,751	47 18 4	10 8 6	36 19 10	4·35
29	AG	Guernsey	4,946	41 3 4	5 3 6	35 19 10	2·51
30	AN	Jersey	6,066	50 10 0	14 11 0	35 19 0	5·76
31	U	Guernsey	6,759	56 5 0	20 7 6	35 17 6	7·24
32	AB	Jersey	5,301	44 16 8	9 18 6	34 18 2	4·49
33	S	Jersey	5,634	46 18 4	12 6 6	34 11 10	5·25
34	G	Jersey	6,516	54 5 0	20 6 0	33 19 0	7·48
35	Q	Jersey	5,382	44 16 8	13 8 6	31 8 2	5·99
36	L	Jersey	5,958	49 11 8	18 18 6	30 13 2	7·63
37	T	Guernsey	5,286	44 0 0	15 0 6	28 19 6	6·82
38	AE	Guernsey	4,554	37 18 4	13 1 0	24 17 4	6·88
39	AK	A.I.S.	5,549	46 3 4	25 2 6	21 0 10	10·88
40	J	Jersey	4,048	33 13 4	13 1 0	20 12 4	7·75
Average	....	....	6,538	54 8 4	13 13 3	40 15 1	5·02

THE SUNFLOWER.

(*HELIANTHUS ANNUUS.*)

By H. G. Elliott, Agrostologist.

THE sunflower originated in North America and to-day is grown extensively in the Argentine, North America, Russia and parts of Europe where the oil from the seed after extraction is used for industrial and domestic purposes, and the residual oil cake or meal has a stock food value on par with linseed meal.

Prior to and during the war, there was only a limited demand for seed in Australia, and this seed was mainly used in the bird seed trade, but the present shortage of vegetable oils has stimulated the interest in the growing of the crop in various States of Australia, principally Queensland.

The possible uses of sunflower seed oil have been classed as follows:—

(a) As an extender or partial substitute for linseed oil in the manufacture of paints and varnishes, but as sunflower oil is a semi-drying oil, paints made entirely from it have unsatisfactory drying rates, but the oil can be used as an extender.

(b) As an Edible Oil.—There is a demand for refined and deodorised sunflower oil as an edible oil in competition with such oils as peanut, maize, olive, cotton and soy bean. The main uses for these oils are for food preparations, food processing, culinary, dried fruit processing, and pharmaceuticals.

(c) Miscellaneous Uses.—There may be a demand for this oil in the manufacture of plasticising materials for the rubber trade, cosmetics and soap manufacture.

There are a number of processing plants in Australia, including Western Australia, which are not operating at full capacity and could process the seed.

Description of the Plant.

It is a hairy, erect and somewhat sparsely branched annual. It grows with rapidity to a height of 12 ft. (giant types) in two to three months, this being due to the plant's power of assimilation and translocation. The plant develops a strong taproot which can penetrate during its growing period to 9 ft.

Varieties and Oil Content.

There are numerous varieties of sunflowers grown commercially and, during recent years, the production of drawf growing varieties have gained prominence as they are suitable for mechanical harvesting.

The oil content of the seed varies according to the varieties, and ranges between 25 and 33 per cent., and one ton of seed produces in the vicinity of 440 lb. of oil.

Some of the more popular varieties and the oil content of the seed are as follows:—

Giant Varieties—	
Mammoth Russian	27-29 per cent. oil.
White and checkered seed	31-33 per cent. oil.
Semi Dwarf—	
Tournesol, Pole Star, Jupiter and Mars	25-30 per cent. oil.
Dwarf—	
Mennonite, Sunrise, Advance Hybrid	25-30 per cent. oil.

Price of Seed.

Prior to World War II, the price of seed was in the vicinity of £14 16s. per ton, and just prior to the commencement of hostilities it rose to £23 per ton. At the present time, the price in Australia varies from £32-£40 per ton.

Value of Residue.

The residue of the seed after oil extraction is a valuable protein rich concentrate for use for stock food. The analyses are as follows:—

Sunflower cake—45 per cent. protein, 10 per cent. oil.

Sunflower meal—35 per cent. protein, 2 per cent. oil.

Soil and Climate.

Sunflowers succeed best in relatively rich alluvial soils, but they can be grown with success on a large range of soils, from sandy loams through to medium-heavy loams. Generally speaking, for best results, conditions which will produce maize crops are suitable for sunflowers, with the exception that sunflowers are much more tolerant to cold than maize, and are more drought resistant. Some of the dwarf types of sunflowers will withstand 5 degrees of frost.

Fertiliser.

Under Western Australian conditions it has been found that on the average soils which have been under subterranean clover for a few years, good results have been obtained from the use of superphosphate at rates from 2-3 cwt. per acre, better results could be obtained by using potato manure B at the same rate per acre.

Soil Preparation.

When sunflowers are grown as a summer crop, the land should be ploughed as early as possible in the winter months and left in a rough state until spring, then worked down so that a good firm seed bed has been obtained.

Sunflowers are susceptible, however, to the ravages of both red mite and lucerne flea, and if sown as a winter and spring grown crop, control of these pests is essential. Weed control is also necessary, as in the early stages they may be retarded in growth by cold conditions.

Time of Sowing.

Sunflowers should be planted late enough to escape the cold in the spring. Mid September to early December will be found the most suitable months.

Method of Sowing.

The seed is usually sown in rows 2-3 feet apart and the single plants should be from 6-12 inches apart in the rows. The American system is to sow in rows 3 feet apart with the plant spaced 6-9 inches.

In America, experimental work carried out at Ithica showed that thicker plantings produced thin stems and these lodged readily. With thinner plantings, thick coarse stems are produced, which are heavy at the top, making handling difficult, if it is grown for silage.

Seeding can be carried out by using an ordinary standard seed drill, the seed being sown through the oat run in the drill box. Rate of seeding varies, from 3 to 8 lb. per acre, according to variety sown and width of drills. Two pounds of seed per acre are sufficient if rows 36in. apart and seed 18in. apart in the rows.

Time of Cutting for Silage.

It is advisable to cut the plants when the seed has reached the milky stage and before any of the leaves commence to drop. As these grow more rapidly than the maize, it may be necessary, if a maize-sunflower silage is required, to sow the sunflowers later than maize, so that both may reach a suitable stage for cutting at the same time. Most dwarf varieties, when sown in the spring, take approximately 90 days to reach this stage, whereas the giant types may take up to 120 days.

Yields.

In Russia they have reached approximately 50 bushels per acre. In the Argentine, in the vicinity of 900-1,000 lb. of seed are obtained per acre.

Experimental trials in this State indicate that in the higher rainfall areas, yields of up to 1½ tons with the dwarf varieties can be obtained. It is estimated that under commercial plantings, yields of up to ¾ ton should be obtained per acre.

Diseases.

Sunflowers are susceptible to rust, and this is known to be present in this State.

Harvesting.

Giant Types.—When sunflowers are to be harvested for seed production, with the giant types, the heads are cut off with about 6 inches of the stalk for ease of handling of the heads. The time they are harvested is when the seeds darken and harden and after the petals have fallen.

Heads, after harvesting, are then spread on floors or racks for drying, as they may heat if they are not stacked in this system, after harvesting. The seed is then knocked out with a flail, winnowed and then spread thinly to dry thoroughly.

Method of Thrashing.

Of the machines that have been tested, the modified maize sheller with a special Helise type drum has given by far the best performance, but the machine cannot deal with the stalks so that the heads must first be cut off. The great advantage of the maize sheller is that it is capable of removing all the seed from dried heads after stooking or ripe heads cut off the standing plants in the field.

Apart from the maize sheller, grain threshers with the American rasp bar type of drum are capable of removing 95 per cent. of the seeds from dried heads, providing the drum speed is reduced to 425 revolutions per minute, most of the concave bars removed and the drums set wide. Such machines are not suitable for undried heads.

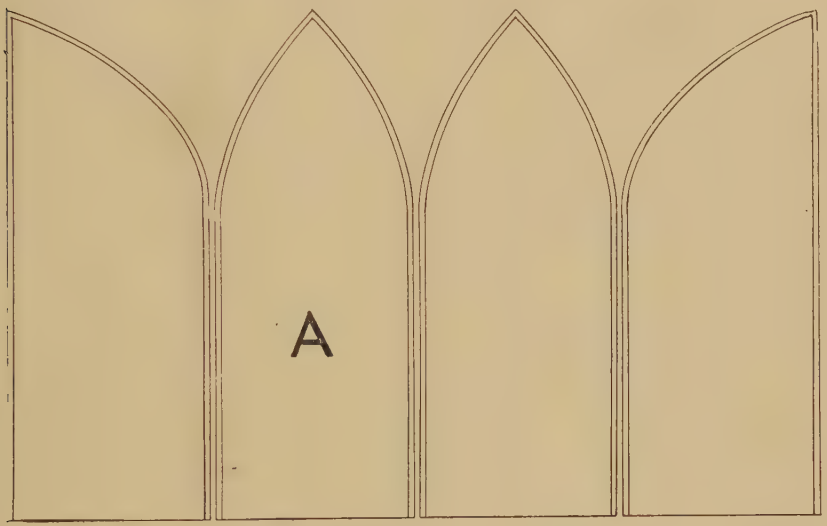
For those people who wish to try sunflowers on a small scale, hand-threshing is not impracticable. The heads should be rubbed face downwards on a small mesh, expanded metal sheeting stretched tightly on a wooden frame, or on a wove wire small mesh, also on a wooden frame. It is estimated that one man can rub out more than 1 cwt. of seed in a day. In dealing with the stems left in the paddock from which the heads only have been cut off, these should be rolled down and immediately disced with tandem discs across the way of rolling before ploughing. For stooked plants, the simplest way is to burn the stems, but the ash should be spread carefully on the land because it is exceptionally rich in potash.

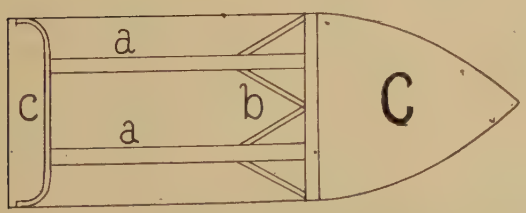
Dwarf Types.

These have been developed for mechanical harvesting and this type of harvesting is carried out in Canada, the Argentine, England and Australia.

In Australia, the following method is used when mechanically harvesting. Successful harvesting has been carried out by a modified header harvester when adjustments are made for the various makes of machines which have basically similar modifications as follows:—

Ground-driven or power machines can be used, but best results are obtained from the power types, as the machines can work at lower speeds for slow moving headers are less likely to knock the ripe plants which causes seed loss.





Legend:

a—3in. x 1in. hardwood stays.

b—1in. flat iron stays.

c—Iron U frame.

d—End of comb.

Diagram showing trays and their attachments.

A—Four trays 7½ft. long, 2¾ft. wide on a 12ft. header.
B and C—Showing how the tray is attached and stayed.

Modifications and adjustments are divided into five groups:—

1. Additions of trays and finger covers.
2. Comb.
3. Reel.
4. Threshing drum.
5. Minor adjustments.

(1) *Trays.*—The standard comb is covered by three or four large 20-gauge galvanised trays with an upturned lip of 1in. on all sides except the base, extending with a slight upward tilt to 7½ft. in front of the comb. These trays catch falling seed and seed heads and guide the stalks and seed heads on to the combs.

The ends of each tray are shaped into points so that the stalks can be guided into the knife.

The trays can be strengthened by the use of 1in. flat or angle iron to enclose the whole of the lipped edge.

The base of each tray is placed on the top of the fingers and attached by small bolts so that the basal edge of the tray just covers the cutting knife. Each tray is independently stayed underneath by means of wood and flat iron or by angle iron.

The finger covers are also made of 20-gauge galvanised iron and attached underneath each tray, each cover being approximately the same width as its corresponding tray to which it is attached about 1ft. in front of comb fingers.

(2) *Comb.*—Remove fingers in the spaces between the large trays and the erection of a guard strip of galvanised iron about 30in. high extending in an upright position from the front of the comb to about 4ft. along the outer edge of the tray nearest the elevator. This vertical guard helps keep the stalks on the trays and prevents them from falling on the machine itself.

(3) *Reel.*—This is raised about 1in. above normal setting. It may be necessary to drill fresh holes in both ends of the reel support in which the axle of the reel revolves. This extra clearance allows for the width of the stalks and clears the upturned lips on the edges of the trays.

(4) *Threshing Drum.*—A pea concave in lieu of the standard concave has been found the best—where the ordinary concave is in use, best results are obtained by removing the concave pegs from the concave floor.

(5) *Minor Adjustments.*—The blast can be reduced to a minimum and the length of the shake of the riddles may need adjustment, as usually the shorter the shake the more satisfactory the results.

When at work, the sunflowers fall on the trays, after being cut by the knife, and the general movement of the machine and the other incoming stalks and heads brush the whole mass back into the spirals, where it has a tendency to be broken up and therefore does not present any great trouble in actual threshing.

One of the greatest difficulties is that in some varieties the stalk is particularly tough and thick, and may cause front elevator trouble. Secondly, the long stalks will jam against the rear hood over the back of the walker case, but in view of the value of the crop, farmers are quite happy to put up with these minor troubles.

If there is only a small area to be harvested, the header can be used quite successfully as a stationary thresher, the heads being cut off with secateurs and fed in on a conventional threshing table. A plain concave should be used and also low speed on the drum.

Varieties Mainly Grown.

Giant Russian.—A vigorous, robust growing variety attaining the height of up to 12ft. The seed is medium-sized, being either grey striped or black. It can be harvested by a header, but in heavy stands one or two rows only should be taken by the machine.

Mennonite.—A dwarf variety usually attaining a height of 3 to 3½ft., but under ideal conditions, up to 5½ft. Heads pendulous, which tend to lodge the plants if heavy rains occur near maturity. The heads are medium size and contain large elongated grey-striped seeds—suitable for header harvesting and a fairly heavy seed yielder.

Advance Hybrid.—This originated in Canada, grows from 3 to 4ft. high, with heads up to 8in. in diameter. The seeds are medium in size and grey striped.

COMPOSITION OF MILK.

A preliminary investigation into the seasonal trend of chemical quality of milk from cows in a herd with a reputation for substandard fats and solids-not-fats.

M. Cullity, Superintendent of Dairying.

J. C. Hood, Deputy Government Analyst, Government Chemical Laboratories.
K. Needham, Agricultural Adviser, Dairy Laboratory.

OVER a period of many years punitive action has been taken against dairymen and vendors selling milk below the standard prescribed in the Food and Drug Regulations.

The contention in some of these cases was that the milk had been adulterated. In other cases where it was considered interference with the milk had not occurred, and therefore, it was admitted to be the natural product of the cow, farmers were given advice, which frequently suggested that the failure to feed a balanced ration was responsible for the trouble.

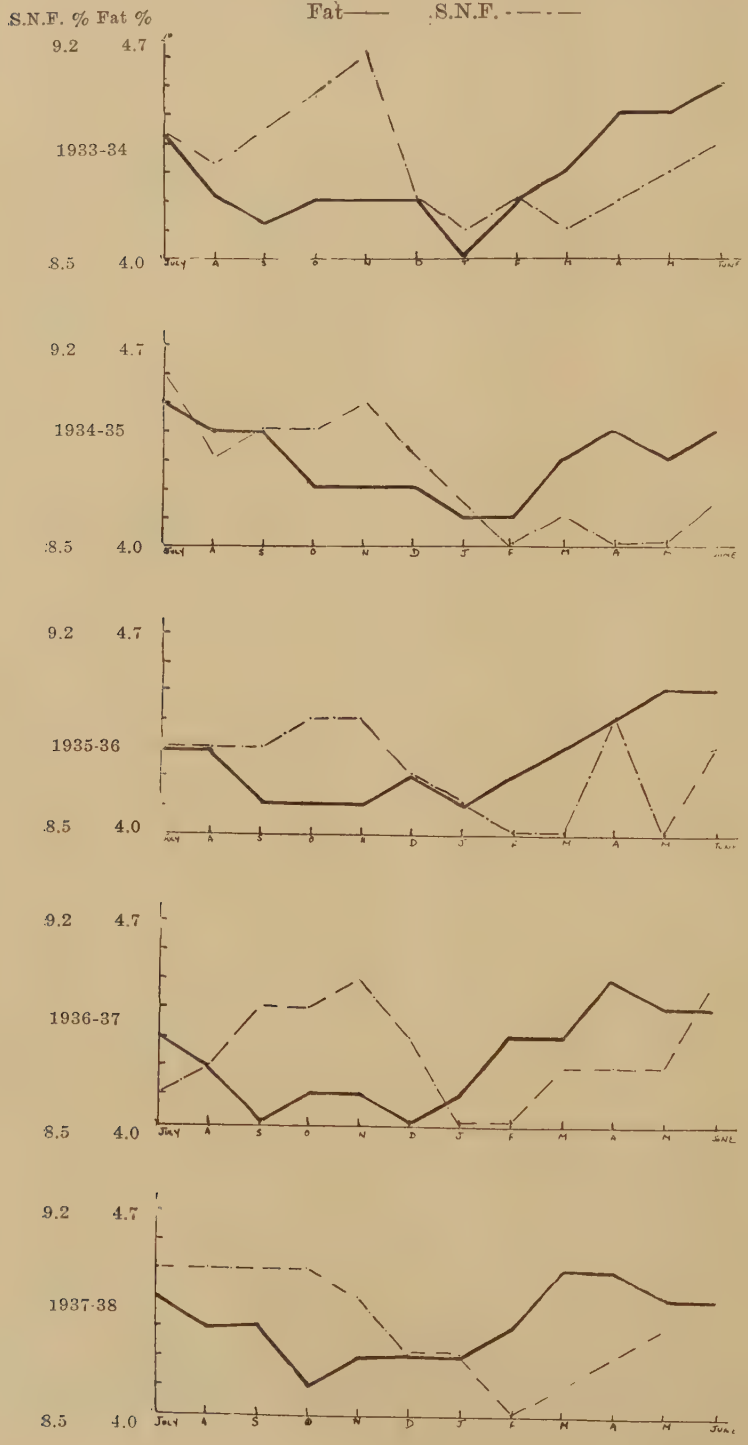
Occasionally, dogmatic advice to feed a certain grain was given as a means of improving quality.

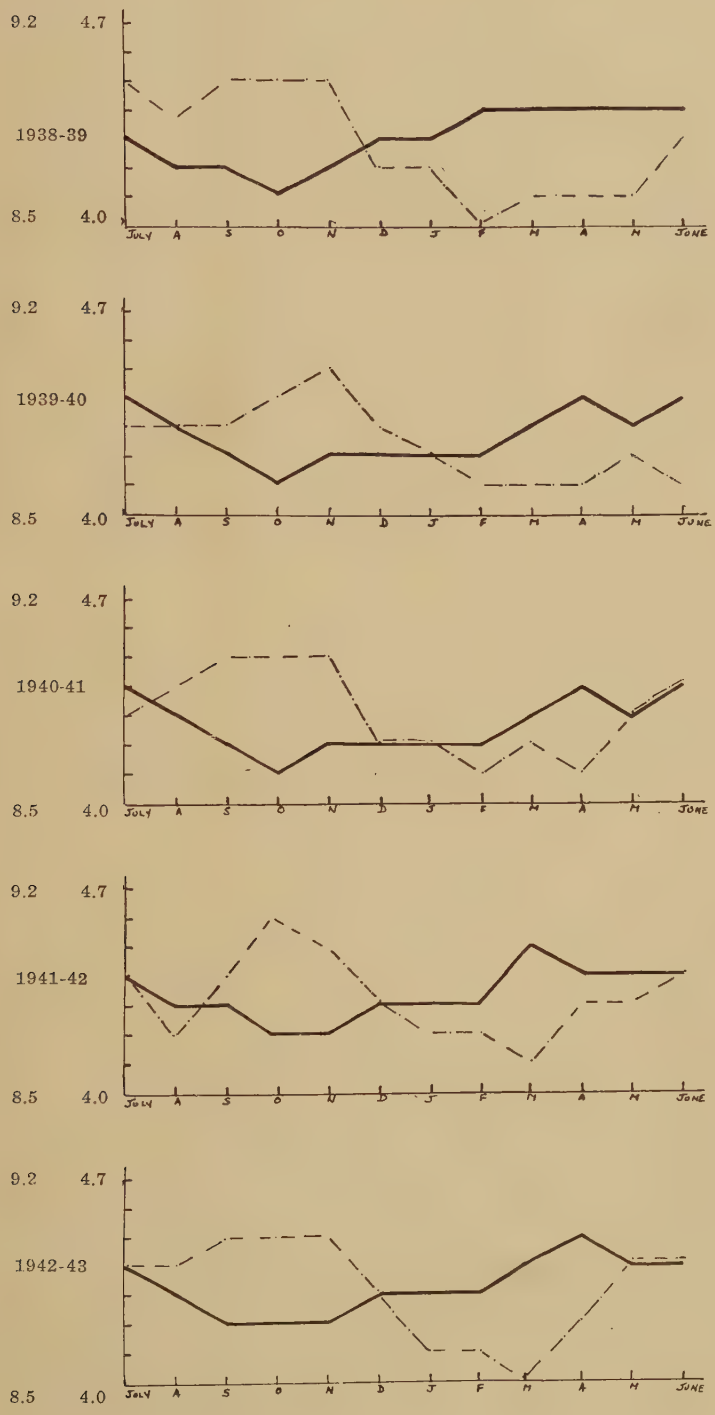
This attitude suggested that feeding was the only factor which could have an effect upon the quality of the milk and ignored variations in composition which may result from a large number of causes, for example those due to—

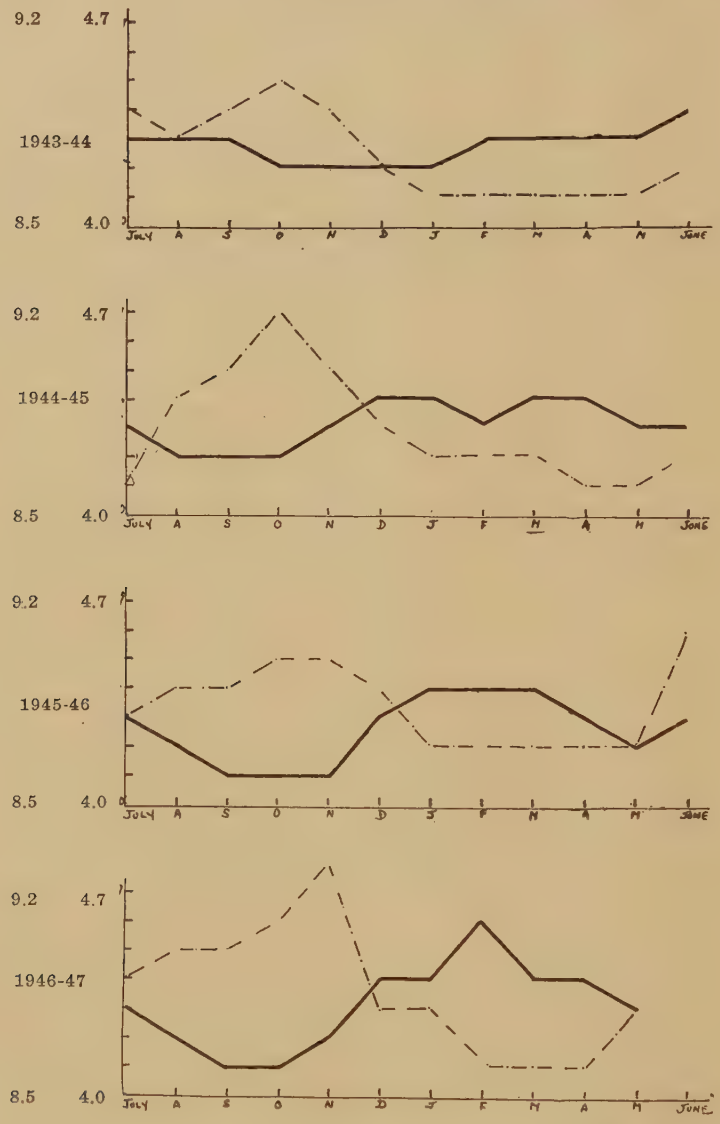
1. Breed.
2. Individuality of the cows.
3. Differences due to unequal periods between morning and evening milkings.
4. The effect of climate.
5. Gross under feeding.
6. The effect of udder disease.

Evidence regarding the trend of composition of bulk milk received at a key dairy produce factory in the State shows considerable changes from season to season in each year, as illustrated by the following graphs of fat and solids-not-fat monthly averages over a period of 14 years from 1933-34 to 1946-47.

FAT and S.N.F. S-WEST FACTORY, 1933-1947.




9.2
4.7
1938-39
8.5
4.0
JULY A S O N D J F M A M JUNE
9.2
4.7
1939-40
8.5
4.0
JULY A S O N D J F M A M JUNE
9.2
4.7
1940-41
8.5
4.0
JULY A S O N D J F M A M JUNE
9.2
4.7
1941-42
8.5
4.0
JULY A S O N D J F M A M JUNE
9.2
4.7
1942-43
8.5
4.0
JULY A S O N D J F M A M JUNE



On some occasions the average value for solids-not-fats has coincided with the minimum standard laid down in the Food and Drug Regulations.

The highest percentage of butterfat occurred in the months of May to July while the lowest was during the period from October to February.

Percentages of solids-not-fat did not follow the same trend, but appeared to have an opposite movement, although in the graphs, the peaks did not coincide with the troughs of the fat, nor the troughs with the peaks of the fat.

The highest percentage of solids-not-fat occurred in the months of September to November, while the lowest values were in December to January. From November to February both fats and solids-not-fat were low. Thus the total effect was to make the chemical composition of the milk at its worst during this latter period.

It has been felt for some time that the factors responsible for the variations were not understood and at a meeting of the Inter-Departmental Technical Committee on Dairy Products* the matter was discussed and a decision made to carry out an investigation into the trend of composition of the milk of individual cows. This inquiry was intended as a preliminary to a possible further examination of the chemical standard of whole milk supplied generally in this State.

Owing to the difficulty of procuring supplies from commercial dairies, the bulk of which are using releaser type of milking machines the choice of a herd was restricted. The one finally selected was milked by hand, the owner having been prosecuted on numerous occasions for having sold under standard milk. This fact must be emphasised as it makes it impossible to consider the results obtained and described in this report as being applicable to the average milk received in the metropolitan area.

Examination of a Metropolitan Herd.

A dairyman made available at first six and later ten cows from his herd and on October 15, 1945, sampling was commenced, the number being increased to ten on the 29th October of the same year. These animals were selected by the owner as being a fair average sample of the herd. Details of the animals under test are as follow:—

Breed.	Age.	Date of last calving.	Period in milk months.
1 Favourite— Three Quarter Shorthorn	10 years	July, 1945	3½
2 Freda— Fresian	6 years	End of July, 1945	2½
3 Irene— Almost pure breed Shorthorn	6 years	Early September	1½
4 Marie— Pure Bred Fresian	10 years	July	3½
5 Rosie— Fresian	10 years	July	3½
6 Susie— Fresian	6 years	July	3½
7 Josephine— By Shorthorn Bull out of Jersey Cross	4 years	End of August	1½
8 Nancy— Pure Breed Shorthorn	7 years	June	4½
9 Gwennie— Pure Breed Fresian	7 years	July	3½
10 Roma— Mainly Shorthorn Balance Indeterminate	16 years	Early September	1½

Sampling Technique and Hours of Milking.

Evening and morning samples were taken weekly as far as possible on Monday afternoon and Tuesday morning. The cows were hand milked and one of the authors taking the samples was present during milking. The milk was poured from the milker's bucket into the sampler's bucket immediately on completion of milking, weighed and sampled into an 8 oz. bottle with a long handled dipper. The evening samples were held over night in a refrigerator and were delivered to the laboratory for testing along with the morning samples by 10 a.m. No preservatives were added.

*Consisting of M. Cullity (Chairman), Department of Agriculture, J. C. Hood (Convener), Government Chemical Laboratories, Mr. Dowe, Public Health Department, Mr. J. Hoare, Government Chemical Laboratories, and Mr. K. Needham, Department of Agriculture.

Feed and Management.

No effort was made to alter the existing methods of management of the herd. In mid-December, 1945, the animals were on a ration composed of pollard, bran, branato and sweet dairy food. Added to this they received in the bail, chopped green feed in the form of paspalum and sub-clover and intermittently chopped spinach and brewers' grain.

During the summer months, although the animals were allowed free range between milking, green feed in the form of pasture was practically non-existent, and the picking of dry feed was sparse.

The nutritive ratio of the ration which was maintained until the middle of May was in the vicinity of 1 : 6, from the middle of May, 1946, the brewers' grains were reduced in volume to half, and from July the ration was still further widened by the elimination of the brewers' grain, and the reduction of the concentrates to half. There was, however, a slight increase in the volume of green feed supplied in the bail. From July until the conclusion of testing, October, 1946, this ration was maintained, and, owing to the poor grazing conditions during winter and spring, very little green feed was available as free grazing.

Sickness.

Throughout the 12 months period, the animals appeared to be in a fair condition, and suffered no apparent illness throughout the period under review. Upsets were confined to minor injuries of short duration. Subsequent to the completion of testing, the whole of the herd of this dairyman was subject to examination by the tuberculin test and it was found that a very high percentage of the herd gave a positive reaction. Enquiries revealed that four of the test animals, Nos. 4, 5, 7 and 10 were positive, but unfortunately no information could be obtained from the owner concerning the remainder. It is possible that these may have been disposed of prior to the tuberculin examination. According to a report of Sub-Committee of the Scientific Advisory Committee of the Department of Health for Scotland (i.) milk from tuberculous cows still gives normal freezing point depressions.

Chemical Examinations Made.

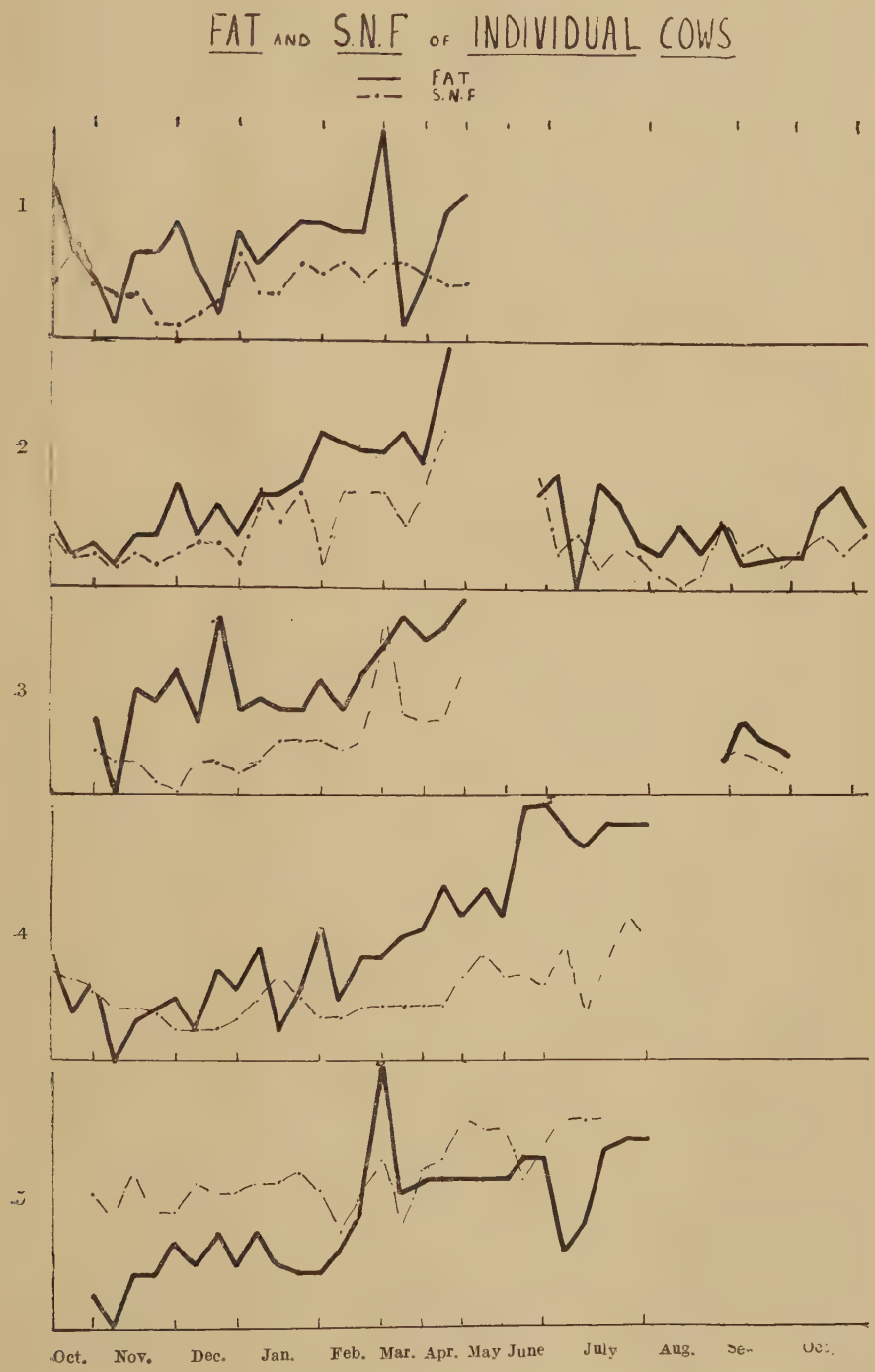
The samples were examined for fat, total solids, protein, lactose (by difference) ash, and freezing point depression. With respect to the freezing point depression, it was originally intended that individual examination would be made on each animal. However, it was necessary subsequently to discard this procedure and accordingly the a.m. and p.m. samples were bulked together and freezing point depressions were determined.

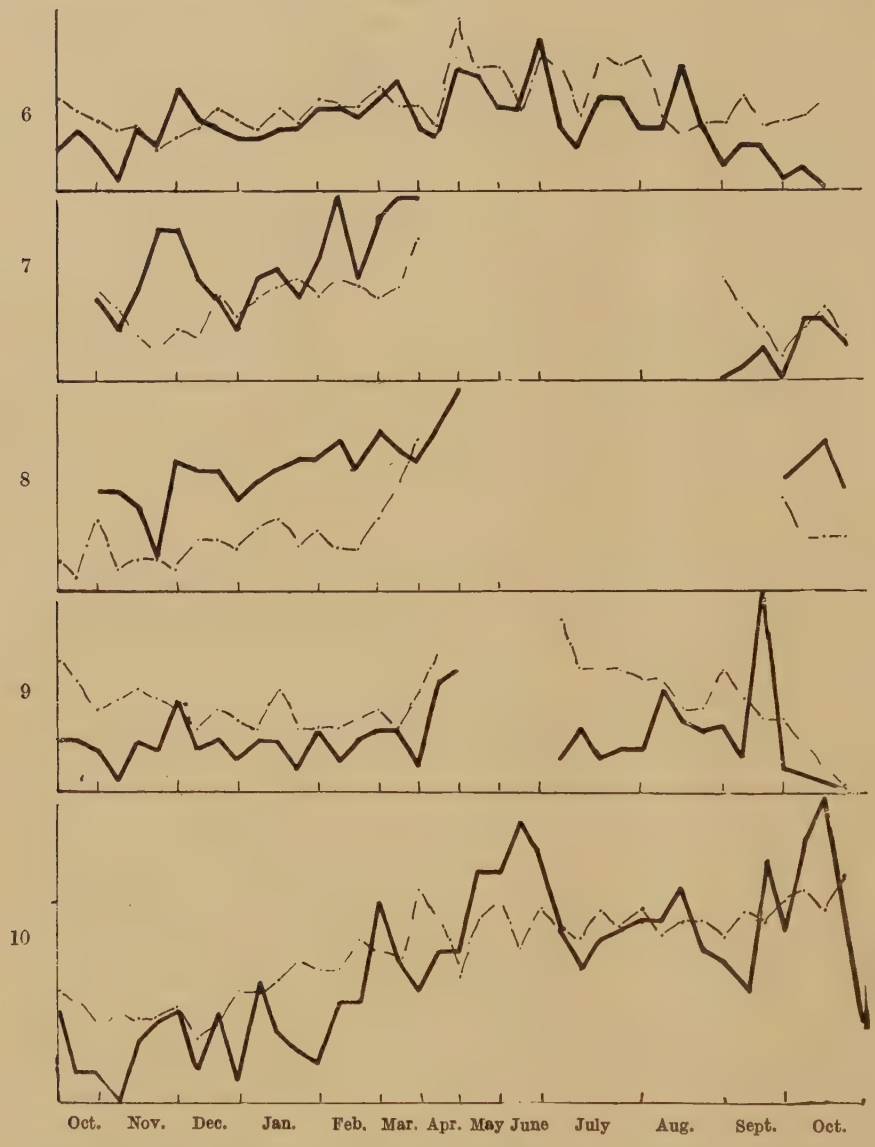
Fat.

The Food and Drug Regulations for Western Australia stipulate a minimum standard of 3.2 per cent. fat. Of the 576 examinations made 108 or 18.7 per cent. were below the minimum standard of 3.2 per cent. The average figure for the herd was 3.7 per cent. Of the total examinations made, 252 samples or 43.75 per cent. were above the herd average.

The graphs of the fat content for the individual animals, indicate a peak in February and March with a trough in October and November. The period of low fat content, corresponds fairly well with the information obtained from the factories in the South-West, although it occurs a little later. The peak, however, occurs considerably earlier in February and March as opposed to April and July in the South-West. With the exception of one cow all were more often than not above the minimum standard of 3.2 per cent. allowed.

(i) The freezing point (Hortvet) test of milk. Department of Public Health for Scotland—Report of Sub-Committee of the Scientific Advisory Committee, 1946.


FAT AND S.N.F OF INDIVIDUAL COWS
FAT
S.N.F
1
2
3
4
5
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sep.
Oct.



Solids-not-fat.

The minimum standard required in the Food and Drug Regulations for the solids-not-fat is 8.5 per cent. and 307 or 53.3 per cent. of the samples failed to measure up to this requirement. The herd average was 8.53 per cent. of which 252 or 43.75 per cent. were above the average.

The graphs indicate the peak in the solids-not-fat in February and April, with the lowest peak in the solid-not-fat in almost the exact opposite of the condition obtained in the South-West irrigation areas.

Of the 10 cows, four have been consistently below the minimum standard for solids-not-fat, five have been irregular and only one has been consistently above the standard.

Freezing Point Depression.

The Western Australian standard for freezing point depression is –0.540°C. That recommended by the Scottish Ministry of Health is –0.530°C.(2) and in the following tables the results have been compared against both standards.

The following table shows the results of the 44 samples which it was possible to subject to individual cryoscope examinations and the relationship of this to the solids-not-fat content.

TABLE No. 1.
FREEZING POINT DEPRESSION ON INDIVIDUAL SAMPLES.

No. of Samples.	Solids not fat, less than 8·5%.	Freezing Point Depression less than —0·540°C.	Freezing Point Depression less than —0·530°C.
44	24 (54·9%)	29 (65·9%)	9 (20·4%)

TABLE No. 1A.
A.M.

No. of Samples.	Solids not fat, less than 8·5%.	Freezing Point Depression less than —0·540°C.	Freezing Point Depression less than —0·530°C.
22	13 (59·1%)	16 (72·7%)	8 (36·4%)

TABLE No. 1B.
P.M.

No. of Samples.	Solids not fat, less than 8·5%.	Freezing Point Depression less than —0·540°C.	Freezing Point Depression less than —0·530°C.
22	11 (50·0%)	13 (59·1%)	1 (4·5%)

Of these samples 54.9 per cent. (24) were low in solids-not-fat and 65.9 per cent. gave a freezing point depression lower than –0.540°C. and 20.4 per cent. (9) were less than –0.530°C. From tables 1A and 1B it will be seen there is a tendency for both the freezing point depression and the solids-not-fat to be below standard in the a.m. samples.

It is interesting to observe that the Scottish Ministry of Health[2] stated that only on rare occasions will the samples normally low in solids-not-fat show a lowered freezing point depression.

TABLE No. 2.
FREEZING POINT DEPRESSION OF INDIVIDUAL SAMPLES LESS THAN 8·5 PER CENT. SOLIDS NOT FAT, IN TABLES 1, 1A, 1B, ABOVE.
A.M. AND P.M.

Solids not fat, less than 8·5 %.	Freezing point depression, less than —0·540°C.	Freezing point depression less than —0·530°C.
24	19 (79·1%)	7 (29·1%)

[2]Liquid Milk and Nutrition. The freezing point test in the Australian Milk and Dairy Products Journal, December, 1945, page 25.

TABLE NO. 2A.

A.M.

Solids not fat, less than 8·5 %.	Freezing point depression less than —0·540°C.	Freezing point depression less than —0·530°C.
13	11 (84·5%)	7 (53·9%)

TABLE NO. 2B.

P.M.

Solids not fat, less than 8·5%.	Freezing point depression, less than —0·540°C.	Freezing point depression less than —0·530°C.
11	8 (72·7%)	*Nil*

Tables 2, 2A and 2B demonstrate that of the 24 samples which were below 8.5 per cent. solids-not-fat, 79.1 per cent. (19) showed a freezing point depression of less than –0.540°C. and 29.1 per cent. (7) less than –0.530°C. with the greater number below standard occurring in the a.m. group.

TABLE NO. 3.

FREEZING POINT DEPRESSION OF BULK SAMPLES.

A.M. AND P.M.

No. of Samples.	Solids not fat, less than 8·5%.	Freezing Point Depression less than —0·540°C.	Freezing Point Depression less than —0·530°C.
73	33 (45·2%)	64 (87·6%)	34 (47·9%)

TABLE NO. 3A.

A.M.

No. of Samples.	Solids not fat, less than 8·5%.	Freezing Point Depression less than —0·540°C.	Freezing Point Depression less than —0·530°C.
36	16 (44·4%)	33 (91·6%)	26 (72·2%)

TABLE NO. 3B.

P.M.

No. of Samples.	Solids not fat, less than 8·5%.	Freezing Point Depression less than —0·540°C..	Freezing Point Depression less than —0·530°C.
37	17 (45·9%)	31 (83·8%)	9 (24·3%)

Tables 3, 3A and 3B show that whilst there is little appreciable difference between the a.m. and p.m. incidence of low solids-not-fat the percentage of low freezing point depression is greater in the a.m. samples as was the case with the individual freezing point depression determinations.

Table No. 4.

FREEZING POINT DEPRESSION OF BULK SAMPLES LESS THAN 8·5% SOLIDS NOT FAT, IN TABLES NOs. 3, 3A, AND 3B, ABOVE.

A.M. and P.M.

Solids not fat, less than 8·5%.	Freezing point depression, less than —0·540°C.	Freezing point depression less than —0·530°C.
33	27 (81·8%)	11 (33·3%)

Table No. 4A.

A.M.

Solids not fat, less than 8·5%.	Freezing point depression less than —0·540°C.	Freezing point depression less than —0·530°C.
16	14 (87·5%)	9 (56·3%)

Table No. 4B.

P.M.

Solids not fat, less than 8·5%.	Freezing point depression less than —0·540°C.	Freezing point depression less than —0·530°C.
17	13 (76·5%)	2 (11·8%)

It should be remembered that the possibility of adulteration of the samples must be excluded, as in all instances they were taken under the observation of one of the authors.

It appears from the foregoing, therefore, that normally occurring low solids-not-fat samples will not necessarily give a normal freezing point depression.

Protein, Lactose and Ash.

With reference to the examinations made for protein, lactose and ash, no standards are laid down under regulation in Western Australia. For purposes of comparison the following average figures were used. Protein 3.43 per cent., lactose 4.75 per cent. and ash 0.72 per cent. The corresponding herd averages for the 10 cows under test were protein 3.11 per cent., lactose 4.68 per cent. and ash 0.73 per cent.

Table No. 5.

PROTEIN.

A.M. and P.M.

	Less than 3·43%	Greater than 3·43%	3·43%
No. of samples	425	146	5
Percentage	73·8	25·3	0·9

Table No. 5A.

A.M.

	Less than 3·43%	Greater than 3·43%	3·43%
No. of samples	215	68	3
Percentage	75·2	23·8	1·0

Table No. 5B.

P.M.

	Less than 3·43%	Greater than 3·43%	3·43%
No. of samples	211	77	2
Percentage	72·8	26·6	0·6

Table No. 6.

A.M. and P.M.

	Less than 3·11%	Greater than 3·11%	3·11%
No. of samples	286	282	8
Percentage	49·7	49	1·0

Table No. 6A.

A.M.

	Less than 3·11%	Greater than 3·11%	3·11%
No. of samples	145	136	5
Percentage	50·7	47·6	1·7

Table No. 6B.

P.M.

	Less than 3·11%	Greater than 3·11%	3·11%
No. of samples	143	144	3
Percentage	49·3	49·7	1

Table 5 illustrates the position using the average figure of 3.43 per cent. and Table 6 using the herd average of 3.11 per cent. Table 5 shows that 73.8 per cent (425) of the samples were lower than average, and 286 or 49.7 per cent. lower than the herd average.

Table No. 7.

LACTOSE.

A.M. and P.M.

	Less than 4·75%	Greater than 4·75%	4·75%
No. of samples	305	263	8
Percentage	53	45·7	1·3

Table No. 7a.

A.M.

	Less than 4·75%	Greater than 4·75%	4·75%
No. of samples	143	140	3
Percentage	50	49·0	1

Table No. 7b.

P.M.

	Less than 4·75%	Greater than 4·75%	4·75%
No. of samples	163	122	5
Percentage	56·2	42·1	1·7

Table No. 8.

A.M. and P.M.

	Less than 4·68%	Greater than 4·68%	4·68%
No. of samples	271	302	3
Percentage	47	52·4	0·5

Table No. 8a.

A.M.

	Less than 4·68%	Greater than 4·68%	4·68%
No. of samples	129	157	*Nil*
Percentage	45·1	54·9	....

Table No. 8b.

P.M.

	Less than 4·68%	Greater than 4·68%	4·68%
No. of samples	146	141	3
Percentage	50·4	48·6	1·0

Tables 7 and 8 show results of the lactose determinations using averages of 4.75 per cent. and 4.68 per cent. respectively. In the case of the lactose 53 per cent. or 305 samples were below the average of 4.75 per cent and 271 or 47 per cent. below the herd average of 4.68 per cent.

TABLE No. 9.

ASH.

A.M. AND P.M.

	Less than 0·72%	Greater than 0·72%	0·72%
No. of samples	225	299	51
Percentage	39·1	52·0	8·9

TABLE No. 9A.

A.M.

	Less than 0·72%	Greater than 0·72%	0·72%
No. of samples	123	129	34
Percentage	43·0	45·1	11·9

TABLE 9B.

P.M.

	Less than 0·72%	Greater than 0·72%	0·72%
No. of samples	103	170	17
Percentage	35·5	58·6	5·9

TABLE No. 10.

A.M. AND P.M.

	Less than 0·73%	Greater than 0·73%	0·73%
No. of samples	273	263	40
Percentage	47·2	45·7	6·9

TABLE No. 10A.

A.M.

	Less than 0·73%	Greater than 0·73%	0·73%
No. of samples	184	77	25
Percentage	64·3	26·9	8·8

Table No. 10b.

P.M.

	Less than 0·73%	Greater than 0·73%	0·73%
No. of samples	120	153	17
Percentage	41·4	52·8	5·8

Tables 9 and 10 set out the position in respect to ash using an average of 0.72 per cent. and a herd average of 0.73 per cent. Here, 39.1 per cent. or 225 of the samples were less than 0.72 per cent and 273 or 47.2 per cent. were less than 0.73 per cent.

Herd Averages.

It is interesting at this stage to compare the position of the herd averages in respect to the standards prescribed by the Food and Drug Regulations of Western Australia and the averages used for comparative purposes.

	Herd Averages.	Food and Drug Standard and comparative averages.
	%	%
Fat	3·73	3·2
Solids not fat	8·53	8·5
Total Solids	12·26	11·7
Protein	3·11	3·43
Lactose	4·68	4·75
Ash	0·73	0·72

It will be seen that the herd averages for fat, solids-not-fat and ash are above the Food and Drug Regulations and comparative averages, but that the protein and lactose are below them.

CONCLUSIONS.

The results obtained indicate the following:—

1. Despite the fact that the herd average for fat and solids-not-fat is above the minimum standards prescribed by the Food and Drug Regulations, at certain times of the year, the fat and solids-not-fat are seriously under standard.
2. There is a seasonal variation in the chemical composition of the milk.
3. Many of the samples fail to meet the requirements of the freezing point depression standard.
4. The claim that the freezing point depression will be normal in normally low solids-not-fat samples is not borne out.
5. The herd average for protein is low.
6. The herd average for lactose is low.
7. The herd average for ash is satisfactory.

The authors of the above and the Inter-Departmental Technical Committee desire to point out that the results of this examination are not being taken as being indicative of milk quality throughout Western Australia. They referred simply to data obtained over a period of 12 months from the examination of 10 cows in one of the herds which was known to be producing substandard milk, which later was found to be heavily infected with tuberculosis.

The inquiry was intended merely as a preliminary to disclose the necessity for further and more extensive investigation. This, when practicable, will need to cover a more representative sample of the dairy herds and to test the effect of many varying conditions under which milk is produced.

C.S.I.R. INFORMATION SERVICE.

CHANGE OF ADDRESS.

Readers are advised that the C.S.I.R. Information Service has changed its address and is now located at C.S.I.R. Head Office,

314 ALBERT STREET, EAST MELBOURNE, C.2.
Telephone J.A. 6611.

THE COOLING OF MILK ON DAIRY FARMS.

A. H. Hobbs, H.D.D., Dairy Produce Inspector.

REGULATIONS under the Dairy Industry Act have recently been gazetted which provide for the compulsory grading, and payment for, according to grade, of all milk supplied to dairy produce factories in this State for manufacturing purposes.

The primary object of this legislation is to induce dairy farmers to supply milk of the best possible quality, and thus bring about an improvement in the finished product.

It is common knowledge that the bacteria responsible for the deterioration of milk, multiply most rapidly at the temperature at which the milk leaves the cow, (approximately 98°F.). This applies more particularly to those types which produce undesirable flavours and odours by their action on the milk constituents.

Investigations have shown that over a period of nine hours the approximate increase in the number of bacteria in milk is as follows:—

Held at	Increase
60°F	each organism increases to 5
77°F	each organism increases to 107
95°F	each organism increases to 3800

Thus it can be seen that if the temperature of the milk is allowed to remain at the blood temperature of the cow, the increase in bacterial development will be extremely rapid.

As the temperature decreases, bacterial action is retarded until a stage is reached as the temperature approaches freezing point where the organisms are virtually dormant.

The aim of the milk producer then should be to reduce promptly the temperature of his product to as low a figure as possible immediately it is drawn from the cow, in an endeavour to ensure that the milk will command the maximum price when delivered to the factory.

In addition to cooling the milk when freshly drawn, it is essential that it be kept cool. Morning milk promptly cooled and delivered early should be in good condition on arrival at the factory. Milk produced in the evening and held overnight on the farm must be kept at a low temperature. Therefore in addition to cooling it as it comes from the cow, some means of maintaining this low temperature is necessary otherwise in warm weather it will soon return to the temperature of the atmosphere.

Experiments have shown that water will conduct heat approximately twenty-one times as fast as air. This means that by allowing the milk to come in contact with a water cooled metal surface, the milk will be cooled twenty-one times faster than if allowed to stand in air at the same temperature.

Unfortunately during the summer months supplies of cold water are not always readily available on dairy farms. A survey carried out by the author for the inter-departmental committee on milk quality during March, 1945, revealed that on forty-three farms taken at random between Perth and Brunswick, the average temperature of well water being used for cooling milk was 74°F. The lowest temperature recorded was 64°F, in which case the water was pumped direct from the well to the surface cooler. Temperatures as high

as 92°F were recorded where water was stored in unprotected overhead tanks during the day. It is obvious that any attempt to cool milk with water as mentioned in this latter case would be worthless.

Without the aid of mechanical refrigeration great reduction in the temperature of the milk is not possible; but with water at 65-70°F a reduction of at least 25°F can be obtained, which at all times, and particularly during the warmer portion of the year, is most beneficial.

If water is available at this temperature, and the well is adjacent to the milk room, the most effective method is to couple the pump direct to the cooler. If this is not practicable and the water has to be held in an overhead tank it will absorb heat and some means of cooling it prior to use is essential.

Apart from mechanical refrigeration, the only method by which water can be cooled on the farm is by natural evaporation using a specially constructed cooling tower.

The lowest temperature possible by this means is the wet-bulb temperature existing at the time in the vicinity.

The following figures for wet-bulb temperatures obtained from the weather bureau indicate the degree to which water may be cooled by the evaporative method in the areas given:—

MONTH.	AVERAGE WET-BULB TEMPERATURES OF 1946.					
	PERTH.		BUNBURY		MANJIMUP	
	9 a.m.	3 p.m.	9 a.m.	3 p.m.	9 a.m.	3 p.m.
January	60·2	64·3	60·0	64·2	57·2	None Available.
February	59·1	63·9	56·9	63·3	55·5	do.
March	58·3	63·2	57·5	65·0	53·6	do.
April	57·0	62·7	57·1	63·4	54·5	do.
May	54·8	58·7	54·6	58·7	51·2	do.
June	50·2	55·2	49·6	56·4	48·3	do.
July	51·4	54·1	51·5	54·4	47·2	do.
August	49·9	53·5	49·4	54·2	46·5	do.
September	57·1	57·1	52·4	56·7	50·5	do.
October	59·9	59·9	55·1	58·2	53·2	do.
November	59·5	59·5	56·6	60·1	53·6	do.
December	61·1	62·9	59·7	63·9	57·5	do.
Average for 1946	55·6	59·6	55·0	59·9	52·4	do.
ANNUAL AVERAGE	50 years 57·2	60·4	44 years. 57·8	61·7	....	do.

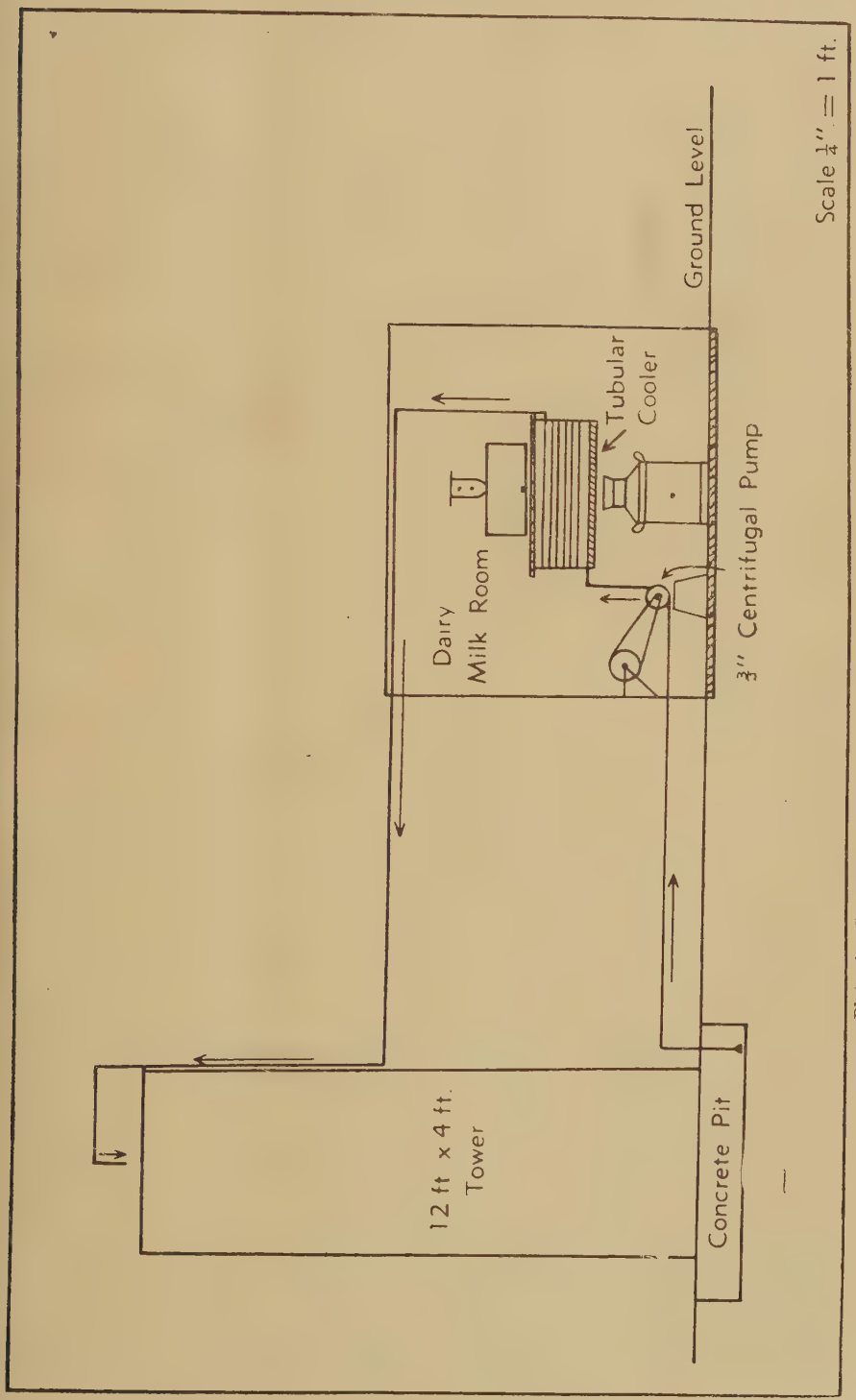


Plate 1.—Showing circulation system using a water cooling tower.

It will be seen that all times of the year in these areas the wet-bulb temperatures are not above 65°F, therefore it is possible with a properly constructed tower, to cool water to this figure even on the hottest day likely to be encountered in the dairying areas in this State.

The following description by F. G. Few, Division of Dairying, Department of Agriculture, Queensland, Queensland Agricultural Journal, May, 1946, illustrates a water cooling system suitable for the average dairy farm which can be expected to give the maximum cooling effect possible by this method. "Plate 1 shows the general arrangement of the tower re-circulated water cooling system. The water is drawn from the 1ft. deep concrete pit below the tower by means of a ¾in. centrifugal pump driven from the dairy house mainshaft as shown.

The water is pumped through the tubular surface cooler and finally delivered for re-cooling at the top of the tower. The tower is placed away from the dairy building to ensure the proper ventilation essential for water-cooling. It should be located on the side of the building exposed to the prevailing winds during the summer months, but need not be far away provided free air access on its four sides is assured. The amount of water needed for re-circulation is not large, and the pit shown on the tower drawings will hold ample water (approximately 200 gallons). A deep pit is not advisable. Tests have shown that water leaving the tower is generally cooler than a larger volume of water in a deep pit, and hence, on mixing, the water leaving for the cooler is higher in temperature than need be. Only sufficient water to properly cover the foot valve is required. The other advantages of a shallow pit are ease of cleaning, safety where children are present, and a greater rate of circulation due to the much smaller suction lift. The cost of construction of a deep pit is also an item of importance, especially if made throughout of concrete, and results have shown that it is no advantage from the viewpoint of efficient cooling.

MATERIALS FOR CONSTRUCTION OF TOWER.

All timber is of undressed hardwood and required concrete made of 4:2:1 mixture. The water distribution tray as shown is preferably of plain galvanised iron with 3in. sides and perforated over its whole base area, although it can be made of boards (6in. by ½in.) closely butted together and with ½in. holes bored along the centre of each board. The timber required is as follows:—

Tower uprights: Four 3in. x 3in., 15ft. long.

Louvres: Start 2ft. from ground level and spaced 5in. apart vertically; 25 are required for each side or 100 for the complete tower. They are of 6in. by ½in. hardwood and are 3ft. 4¾in. in length. Each louvre extends across the 3in. face of the holding 3in. by ⅝in. batten strip resulting in a vertical overlap of ⅝in. and 1½in. measured along the louvre. Eight lengths of battening each 10ft. long are required to hold the louvres.

Tower bracing: Of 3in. by ⅝in. battening. Eight pieces each 7ft. long are required.

Baffles: Made of 6in. by ½in. hardwood. Five are required for each complete baffle, each board being 3ft. 4in. long. For the four sets of baffles twenty such boards are thus required.

The baffle boards are nailed to cross supports, two of 3in. by 1½in. hardwood and 3ft. 6in. long being required for each complete baffle. Similarly these are flushed into the two 3in. by 1½in. supports, each 4ft. long bolted to the tower upright.

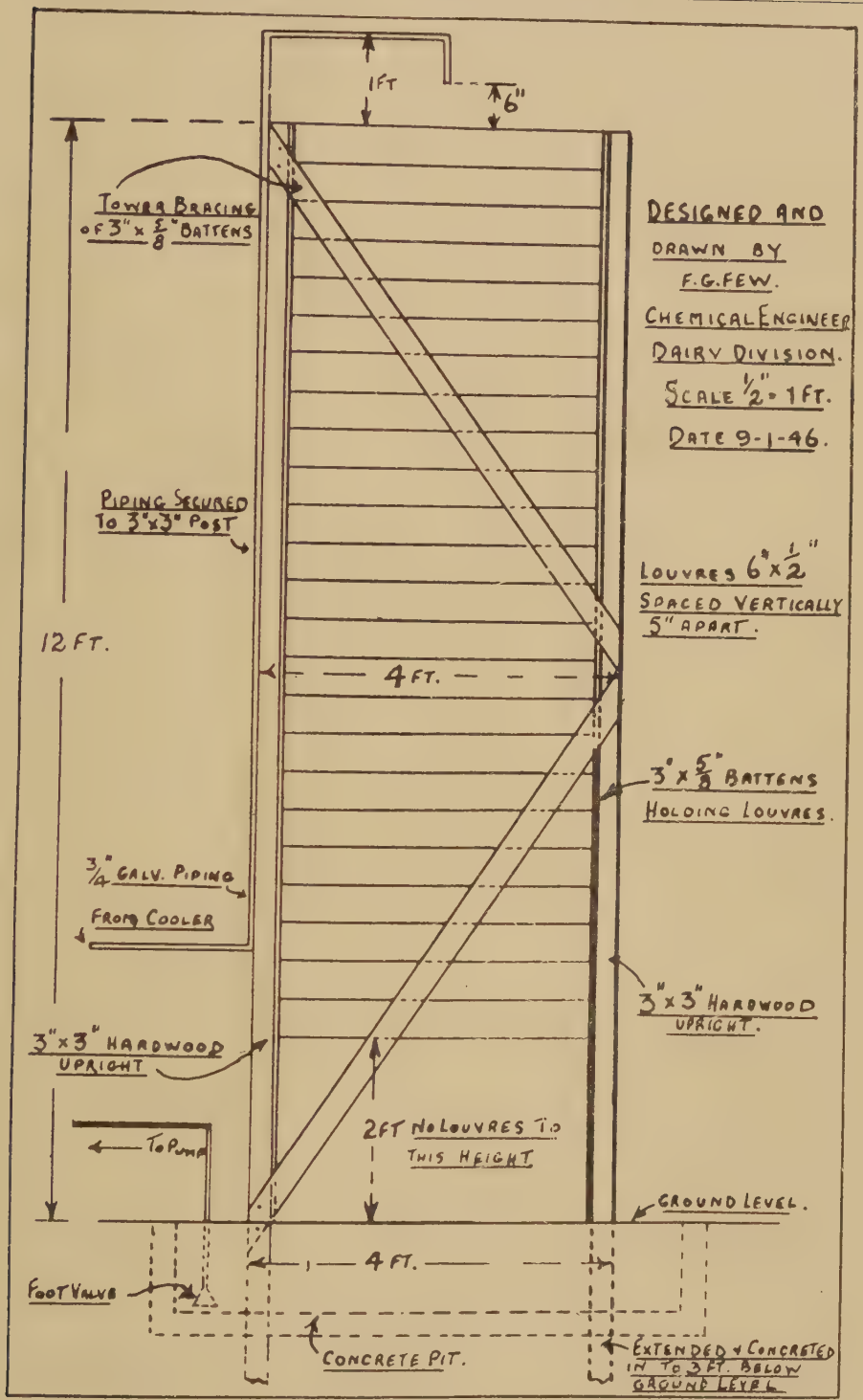

1FT
6"
TOWER BRACING OF 3" x 5/8" BATTENS
DESIGNED AND DRAWN BY F.G.FEW. CHEMICAL ENGINEER DAIRY DIVISION.
SCALE 1/2" = 1FT.
DATE 9-1-46.
PIPING SECURED TO 3"x3" POST
LOUVRES 6" x 1/2" SPACED VERTICALLY 5" APART.
12 FT.
4 FT.
3" x 5/8" BATTENS HOLDING LOUVRES.
3/4" GALV. PIPING FROM COOLER
3"x3" HARDWOOD UPRIGHT.
3"x3" HARDWOOD UPRIGHT
TO PUMP
2FT NO LOUVRES TO THIS HEIGHT
GROUND LEVEL.
4 FT.
FOOT VALVE
CONCRETE PIT.
EXTENDED & CONCRETED IN TO 3FT. BELOW GROUND LEVEL

Plate 2.
Elevation of 4ft. square water cooling tower.

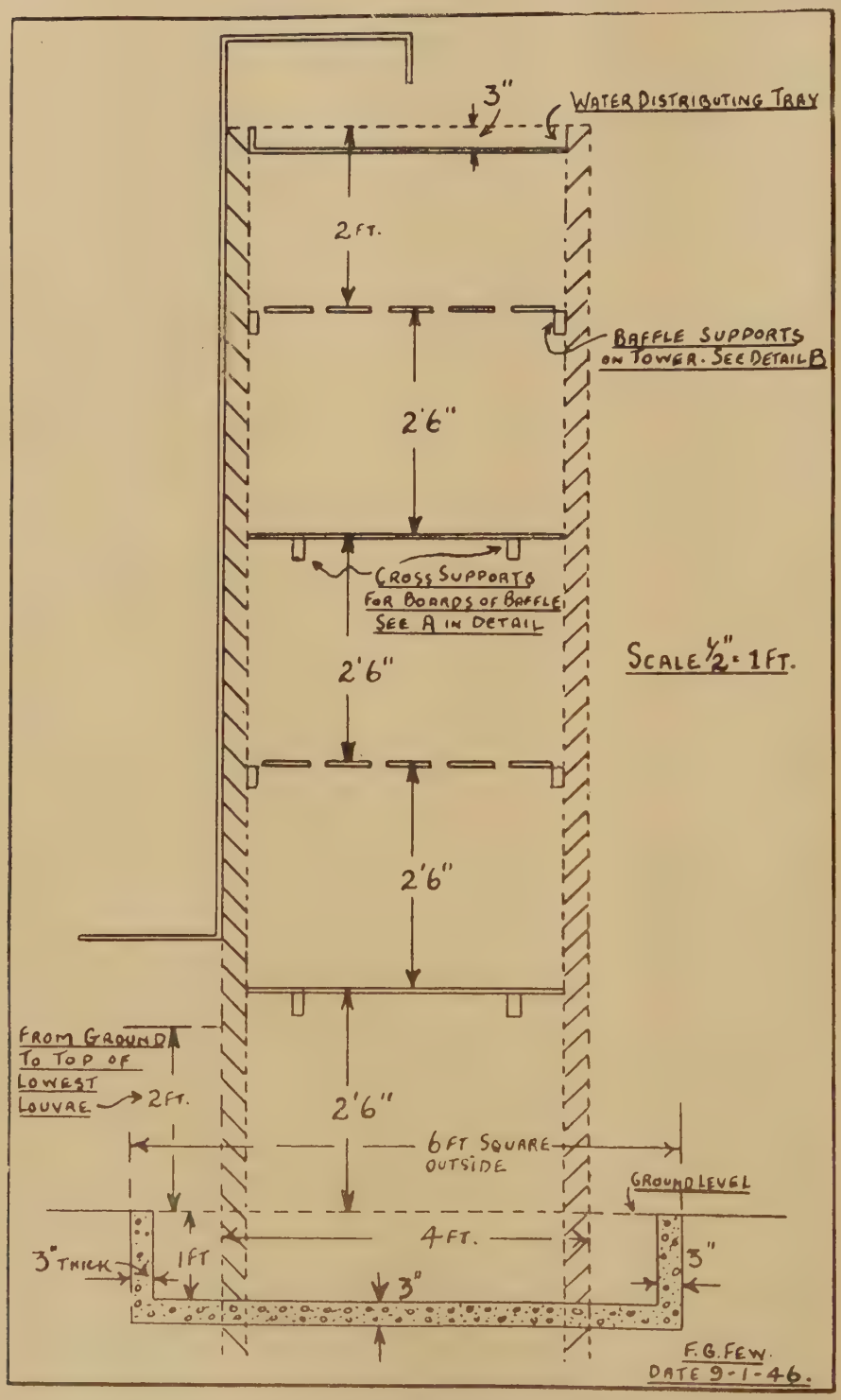


Plate 3.
Sectional elevation showing number and desposition of baffles and concrete pit.

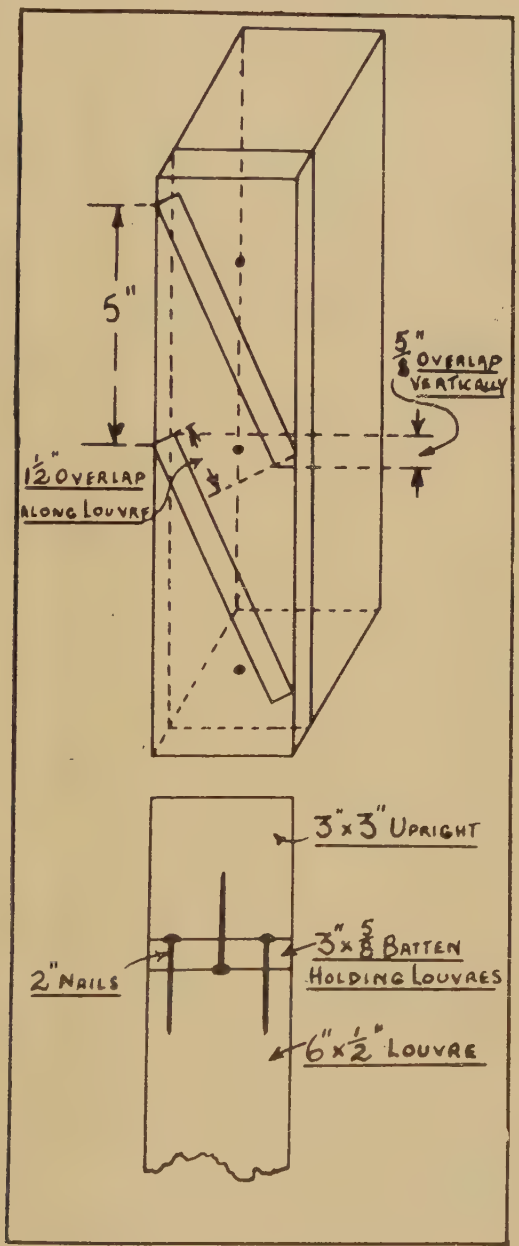


Plate 4.

Details showing method of nailing louvres to batten strips and assembled sections to tower uprights.

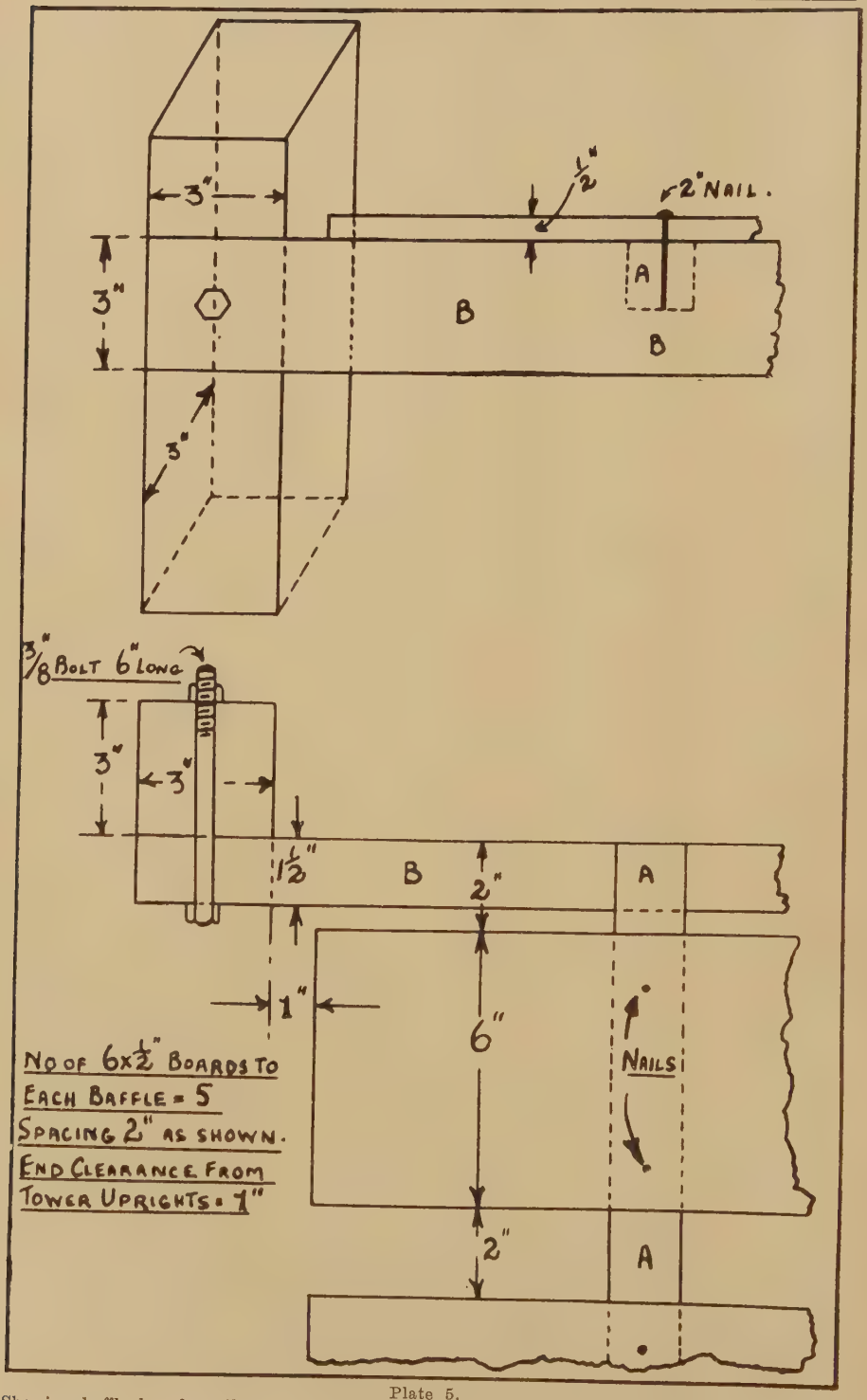


Plate 5.

Showing baffle boards nailed to cross supports A and supports B for completed baffles bolted to tower uprights.

Scale 3in. = 1ft.

—F. G. Few, 9/1/46.

SUMMARY OF MATERIALS REQUIRED.

Timber—

3in. by 3in. hardwood—four lengths of 15ft. each.

6in. by ½in. hardwood—100 lengths of 3ft. 4¾in. each; 20 lengths of 3ft. 4in. each.

3in. by 1½in. hardwood—8 lengths of 3ft. 6in. each; 8 lengths of 4ft. each.

3in. by ⅝in. hardwood—8 lengths of 10ft. each; 8 lengths of 7ft. each.

Concrete: Materials for approximately 20 cubic feet, allowing for concreting in of tower uprights. This requires about two-thirds of a yard of sand-gravel mixture and four bags of cement.

Piping: Threequarter-inch galvanised of a length determined by position of tower relative to dairy building. Clips to hold piping to tower also required.

Bolts and nails: Sixteen bolts each ⅜in. by 6in. long. Nails: Supply of 2in.

Water Distributing Tray: Plain galvanised iron sheet 3ft. 6in. square with 3in. sides soldered.

Circulating Pump: Three-quarter-inch centrifugal pump, belt-driven from shaft in dairy.

Cooler: Standard tubular cooler either for milk or cream, as the case may be.

CONSTRUCTION OF TOWER.

The four tower uprights are erected on the chosen site after first excavating the necessary pit below the ground level. The posts are concreted in the ground up to the level of the bottom concrete of the pit—i.e., up to 1ft. 3in. from the ground level. The baffles and distributing tray are assembled and placed in position as shown on the drawings. Sections of battening from the 10ft. lengths are cut to fit between the supports (B) bolted to the uprights and the appropriate number of louvres are fixed to the battens by nailing through from the outside of the battens into the louvres themselves. The assembled sections are then nailed to the tower uprights, the nails passing through the battens in the reverse direction to those holding the louvres. The tower bracing is then finally secured, and the piping, etc., arranged as required. Construction of the concrete pit is carried out, and any light iron or steel reinforcements available can be advantageously added when laying down. Similarly, a concrete path strip 2ft. wide all round the tower prevents mud, etc., from easily entering the pit during wet weather or following excessive drift loss from the tower due to high winds. The path should slope away from the tower across its width to prevent water entering the pit during wet weather."

The approximate costs in Western Australia of the materials required are as under.

	£	s.	d.
Timber	10	0	0
Cement	1	3	0
Bolts and Nails		7	4
Three-quarter-inch Pump	5	5	0
Three-quarter-inch Piping (say 50ft.) ..	1	7	0
	18	2	4

During the period of the year April to October the dry bulb temperatures (Perth 1946) average for 9 p.m. was 57.5°F., and midnight 56.4°F. Therefore in these months once the evening milk has been cooled, allowing it to stand at atmospheric temperature will achieve as good results as would be possible by any attempt at further natural cooling with water. This, however, does not apply during the rest of the year (November to March) when the averages for 9 p.m. and midnight were 67.0 and 65°F. respectively, with the highest recording for 9 p.m. being 92.1°F. and midnight 86.8°F.

It will be readily realised that if cooled milk is allowed to stand in the atmosphere at these temperatures, the beneficial effect of the original cooling will be largely nullified.

The problem now becomes. "How can the evening milk be kept cool?"

By means of a ball cock in the waterline from the main supply to the pit, and a by pass in the delivery line to the tower, the cooled water in the pit can be diverted to a trough sufficiently deep to allow the cans to be submerged to the level of the milk. This should be done after allowing the water to circulate over the tower for some time after the last of the milk has been run over the cooler, at least during the time taken in cleansing the milking machine and other utensils.

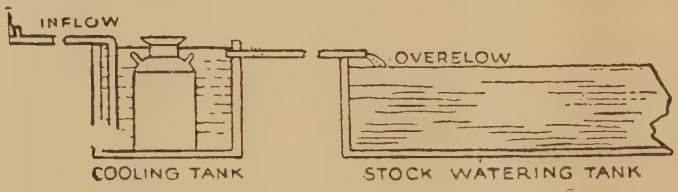


Fig. 6.

It is an economical advantage if the trough is elevated sufficiently to enable the overflow to run to a stock watering tank as illustrated in figure 6.

Even if the water from the well is sufficiently cool to pump directly through the milk cooler, the trough for holding the cans will be used with advantage when filled with fresh water direct from the well after milking is completed.

The lids should be placed loosely on the cans.

Good results can be obtained without the use of a surface cooler, by placing the cans in the cooling trough as soon as they are filled. The trough is filled with cooled water, and the milk and water stirred, using separate stirrers for each, at intervals to ensure uniform cooling. Alternatively, the full cans with lids attached may be rocked in the water. This agitates both the milk and water and obviates contaminating the milk by means of the stirrer. The water in the trough should be changed regularly as its temperature rises. The cooling rate is slower by this method and it is only suitable where unlimited quantities of water are available.

If the cooling has been done with a surface cooler, stirring the milk in the can will not further reduce the temperature unless the night air is cold.

The most efficient milk cooler for farm use is the tubular surface type. These are available in capacities varying from 40-80 gallons of milk per hour at prices ranging from £7 to £15.

Providing the maximum water flow is maintained through the cooler and the milk flow capacity is not exceeded, the milk temperature can be reduced to within 2°F. of the water temperature. It is necessary that the cooler be set to hang perpendicularly so that the milk flow is distributed evenly over the cooling surface.

Some farmers are of the opinion that because the morning milk is delivered to the factory early, that cooling is unnecessary. This is bad practice, and it is important that the morning milk be cooled as soon as it is produced. It should be remembered that the first of this milk may be drawn as early as 5 a.m. and may not reach the factory till 9 a.m. or later. At temperatures of 90°F. and over the undesirable bacterial activity possible during this period is considerable, and even though the milk is accepted at the factory, the deterioration in quality will have a far reaching effect on the finished product.

The full cans should be protected from the rays of the sun at the pick up point and during transit.

The cooling of milk, as outlined in the foregoing will result in a definite improvement in quality. It is necessary, however, for producers to continue to take particular care in the cleansing and sterilisation of all utensils with which the milk comes in contact.

In this respect it should be realised that the tubular cooler is an additional piece of equipment not particularly easy to clean and sterilise, and if neglected may reduce the quality of the milk by increasing the rate of contamination.

RESPONSES OF OATS TO ZINC, PHOSPHATE AND COPPER ON NEWLY CLEARED LIGHT LAND IN WESTERN AUSTRALIA.

By T. C. DUNNE, S. T. SMITH and H. G. CARISS.

Irrespective of whether the immediate aim of the clearing of light land in the wheat and sheep areas is the establishment of pasture or the production of cereals, it is reasonable to assume that the ultimate maintenance of productivity will depend on the alternation of pasture, preferably with a legume base, with cereal crops.

Past experience in many districts has shown that, with normal cultivation and manuring, large areas do not become sufficiently productive of either pasture or cereals until some years after the initial clearing and cultivation. For obvious reasons, this delay in receiving adequate returns has seriously hindered the development of many areas in satisfactory rainfall zones.

Cultivation is usually the first operation in the opening of such areas and subsequently a satisfactory stubble burn is of considerable value for the economic control of regrowth. At the same time, a reasonable cereal grain yield is needed in these early stages if development is to be financed.

The poor crop yields and sparse stubbles obtained on many light soils prompted the investigations reported hereunder. These experiments represent only an attempt to improve by fertiliser treatment the growth and yield of oats on newly cleared light land.

For the purpose of the experiments farmers in widely separated portions of the State offered the use of newly cleared light land which had been fallowed the previous year. The trials were sown and harvested by individual farmers with the help and supervision of departmental officers. Experimental areas were selected at Lake Grace, South Borden, Moora and Kojonup.

Brief descriptions of the sites are as follows:—

Lake Grace—property of D. L. Elliott.

This site is typical of a large area carrying broombush with scattered mallee and acacias. The soil is a brownish yellow sandy loam to loam containing small gravel and overlying massive laterite at depths varying from a few inches to a little over a foot. The soil is fine and powdery when dry but easily worked when wet. It is slightly acid (about pH 5.5)

South Borden—property of J. Campbell.

The area in general is one of sparsely vegetated scrub plain with scattered mallee seldom exceeding 8 ft. in height. The soil of the experiment site was a grey loamy sand with varying amounts of lateritic gravel. At depths varying from 8 to 18 inches the sandy and gravelly surface is underlain by a yellowish brown friable clay. The surface soil was about pH 6.

Moora—property of M. L. Isbister.

The scrub plain of this area consists mainly of fairly deep sandy soil on the slopes and in the depressions with gravel and laterite outcrops on the ridges. On the sloping land of the experiment, the surface was a grey sand which changed with depth to a yellow grey fine sand with ferruginous gravel. This layer extended downward for some feet. The soil is slightly acid (about pH 6).

Kojonup—property of R. E. Cussons.

This experimental site was on land which had previously carried Wandoo (*E. redunca*). The soil consists of a dark grey gravelly sand to a depth of a foot or more below which a yellow tough clay is usually encountered. On this particular site the gravel was quite dense in the surface soil which is slightly acid (about pH 6).

FERTILISER TREATMENTS.

Similar fertiliser treatments were used for the experiments at Lake Grace, South Borden and Barberton where randomised layouts of six treatments replicated five times (30 plots) were used. At Kojonup, the layout consisted of five treatments replicated five times. The fertiliser mixtures used were—

Lake Grace, South Borden, Moora.

Treatment A—Superphosphate 112 lb/ac.

Treatment B—Superphosphate 112 lb/ac. plus crude zinc oxide (Zn) 5 lb./ac.

Treatment C—Superphosphate 112 lb/ac. plus copper ore (Cu) 8 lb/ac.

Treatment D—Superphosphate 112 lb/ac. plus crude zinc oxide 5 lb/ac., copper ore 8 lb./ac., manganese sulphate (Mn) 10 lb./ac., sodium molybdate (Mo) ½ lb/ac.

Treatment E—Superphosphate 224 lb/ac.

Treatment F—Superphosphate 224 lb/ac. plus crude zinc oxide, copper ore.

The crude zinc oxide used contained 50-60% zinc and the copper ore contained about 15% copper.

Kojonup.

Treatment A—Superphosphate 112 lb/ac.

Treatment B—Superphosphate 112 lb/ac. plus zinc sulphate 5 lb/ac.

Treatment C—Superphosphate 112 lb/ac. plus Zinc sulphate 5lb/ac plus copper ore 8 lb/ac.

Treatment D—Superphosphate 112 lb/ac. plus zinc sulphate 5 lb/ac. plus copper ore 8 lb/ac. plus sodium molybdate ½ lb/ac.

Treatment E—Superphosphate 224 lb/ac. plus zinc sulphate 5 lb/ac. plus copper ore 8 lb/ac.

SEEDING.

The seeding was carried out as follows:—

Lake Grace—Oats var. Guyra—40 lb/ac.—June 3, 1948.

South Borden—Oats var. Dale—40 lb/ac.—May 25, 1948.

Barberton—Oats var. Ballidu—40 lb/ac.—May 10, 1948.

Kojonup—Oats var. Fulghum—40 lbs/ac.—May 20, 1948.

Due to the lateness of the opening rains, seeding at the South-eastern centres was later than anticipated.

OBSERVATION OF GROWTH.

The first survey of the experiment was made during August when the best grown plants were about 9in. in height. At that stage, the effect of zinc in promoting healthy growth was quite obvious.

Plants without zinc had developed, on the leaves, a bronze tipping which progressively darkened and extended downward until the outer leaves were completely dark grey to black in colour when they died. Newly emerging leaves developed similar bronze tipping, and it was later noted that these in turn darkened and died. Growth was naturally stunted.

By contrast, the plants to which zinc had been supplied appeared quite healthy. Nevertheless, the plants supplied with 2 cwt. of superphosphate with zinc and copper had made most growth, indicating a stimulus from the higher rate of superphosphate.

In September, the differences between plants supplied with zinc and those receiving only superphosphate was more striking. The latter plants were still stunted and dark in colour whereas the zinc treated plants had made excellent growth. Nevertheless, all plants supplied with the lower rate of superphosphate (1 cwt.) had partially folded leaves which were not apparent on the plants of the 2 cwt. of superphosphate plus zinc and copper plots. Copper fertilisers had not obviously improved growth.

During October, the no-zinc plots began to show recovery and in some instances made rapid growth. Much better crops than might have been expected earlier in the season eventuated at some sites, but in no case did these plots appear to be nearly as good as those supplied with zinc fertiliser.

The oat plants not supplied with zinc matured two to three weeks later than the remainder. At maturity the lower leaves of the no-zinc plants dried a dull grey to greyish black colour, and the straw usually had a greyish tinge. Even where reasonable recovery had been made in spring, the straw never developed brightness and it was still sparse and spindly. The oat grain was greyish, brownish or flecked.

Illustration 1. below, compares plants with and without zinc. Another photograph (Illustration 2.) shows the straw cut after harvesting in plots with and without zinc.

Illustration 1.
Mature plants from plots at Lake Grace.
Plants on left—no zinc.
Plants on right—supplied with zinc oxide.

Illustration 2.
Bundles of straw collected from three square yards after harvesting plots at Lake Grace.
On left—zinc oxide supplied. On right—no zinc.

GRAIN YIELDS.

Lake Grace and South Borden.

The harvesting data for the above centres are given below (Table 1).

TABLE 1.

Treatment.	Lake Grace Guyra Oats Bush. per Acre.	South Borden Dale Oats Bush. per Acre.
Super 112	5·9	11·1
Super 112, Zn	21·2	19·9
Super 112, Zn, Cu	22·6	21·4
Super 112, Zn, Cu, Mn, Mo	21·4	21·5
Super 224	8·4	16·8
Super 224, Zn, Cu	22·4*	25·6
Difference for Significance 1% level	3·2	2·4
5% level	2·3	1·8

* Due to earliest maturity and inclement weather, grain estimated to be at least 10% of the crop shed before harvesting.

The data show clearly the increased grain yield associated with the use of zinc fertiliser. The use of 2 cwt. of superphosphate gives a significantly increased yield as compared with 1 cwt. per acre where no zinc is used. In addition, at South Borden and probably at Lake Grace the plots with zinc and copper produced more grain with 2 cwt. of superphosphate per acre than with 1 cwt. per acre.

Moora.

Unfortunately the yield figures obtained at Moora could not be accepted as being reliable. By the time the no-zinc plots had matured, considerable shedding of grain had occurred on the earlier matured other plots. It should be noted, however, that the plants manured only with superphosphate yielded at the rate of about 15 bushels of oats per acre showing that under certain conditions fair yields can be obtained from plants which were far from promising in the earlier growth stages.

Kojonup

As mentioned above, fewer fertiliser treatments were used at this centre and the yields are shown separately below. (Table 2)

TABLE 2.

Treatments	Kojonup Fulghum oats bush. per acre
Super 112	10.6
Super 112, Zn	16.4
Super 112, Zn, Cu	19.2
Super 112, Zn, Cu, Mo	13.1
Super 224 Zn, Cu	18.0
Difference for significance	
1% level	2.1
5% level	1.5

The figures from Kojonup demonstrate again the benefit to be derived from the use of zinc fertiliser. A further increase in yield was obtained by using copper fertiliser in addition to zinc but extra superphosphate did not improve yields. Molybdenum had the effect of depressing yields.

CONCLUSIONS AND RECOMMENDATIONS.

In view of the fact that the experiments reported above were conducted at widely separated centres, it is reasonable to conclude that manuring only with superphosphate will not produce the best growth or grain yield of oats on newly cleared light land. It is also almost certain that the addition of a zinc compound as a fertiliser will bring about greatly improved yields of oats on such country.

It is therefore recommended, that, where oats are to be grown under these conditions, a zinc compound be used in addition to superphosphate. For this purpose, it is suggested that, until further information is available, zinc oxide be used at the rate of about 3lb. per acre. Zinc sulphate can be used as an alternative but to supply equivalent zinc about 8lb. per acre of this material would be necessary.

Light land which has been cleared for some time may not give similar responses to zinc. Although no experimental data are available, observations in various areas suggest that the abnormal symptoms described above are most severe with the first crop and lessen thereafter even though no zinc has been purposely applied. It seems unlikely that the small amount of zinc normally in superphosphate would altogether account for the improvement noted. Further information should be obtained during the coming season.

It is important to remember that the responses to zinc reported above have been obtained with oats. Wheat, grown under similar conditions, did not show any comparable symptoms nor was its growth badly stunted. Experiments have shown some increased yields where zinc was used with wheat but they were of much less magnitude than those obtained with oats. On the other hand, Wimmera ryegrass without zinc, did show symptoms comparable with those of oats and excellent growth reponses were obtained where this element was used.

It was noted that, in addition to zinc fertilisers, extra superphosphate further increased yields and that the use of higher rates would probably be profitable. In any case, the figures suggest that, for first crops, applications of less than 1 cwt. per acre would be unwise.

The Kojonup experiment, though on light soil, was on land previously carrying Wandoo and can be considered separately from the other areas. Not only did zinc fertiliser give a substantial increase in yield but a further improvement resulted from the use of copper. In a preliminary trial conducted in 1947 many copper deficient plants were found where this element was not supplied. It is therefore recommended that for a cereal crop immediately following clearing of such country, both zinc and copper be used in addition to superphosphate. Either copper sulphate at the rate of 5lb. per acre or copper ore (10 per cent. Cu) at the rate of 12½lb. per acre would be satisfactory.

In spite of the effect of zinc on oats on these light lands, and in spite of the fact that both zinc oxide and zinc sulphate were effective, it is not necessarily certain that the symptoms noted on the superphosphate plots were due to a true zinc deficiency. Both Millikan (1938) in Victoria and Riceman (1945) in South Australia have reported responses to zinc but the symptoms noted in this State were not observed by them. When Piper (1940) grew oats under scientifically controlled conditions, zinc deficient plants developed symptoms quite different from those reported in this paper. These facts, however, do not affect the conclusions reached or the recommendation made for the use of zinc on our new light soils.

SUMMARY.

An account is given of fertiliser experiments with oats conducted on newly cleared light land at Lake Grace, South Borden, Moora and Kojonup.

Excellent responses in vegetative growth and in grain yields were obtained from the use of zinc fertilisers. The symptoms, which consist of bronzing and darkening of the lower leaves with stunted growth, which were developed by plants in the absence of zinc are described.

In addition to zinc, further growth and yield improvement followed the use of a higher rate of superphosphate at some centres and the use of copper fertiliser at Kojonup.

Recommendation is made that zinc fertiliser be used with not less than 1 cwt. per acre of superphosphate on all newly cleared light land being sown to oats. In addition the use of copper is recommended for the type of soil used in the Kojonup experiment.

ACKNOWLEDGMENT.

In addition to the assistance received from the farmers mentioned in this paper, acknowledgment is made of the co-operation of the Road Boards at Lake Grace, Gnowangerup and Moora.

REFERENCES.

Millikan, C. R.—"A Preliminary Note on the Relation of Zinc to Disease in Cereals." Jour. Vic. Dept Agric. 36: 409-16, 1938.

Piper, C. S.—"The Symptoms and Diagnosis of Minor-Element Deficiencies in Agricultural and Horticultural Crops. II. Copper, Zinc, Molybdenum." Emp. Jour. Exp. Agric. 8: 199-206, 1940.

Riceman, D. S.—"Mineral Deficiency in Plants on the Soils of the Ninety-Mile Desert in South Australia. 1. Preliminary Investigations on the Laffer sand, near Keith." J. Coun. Sci. Ind. Res. (Aust.) 18: 336-348, 1945.

BUTTER-FAT READY RECKONER

(20-100 lbs.: 30-50 per cent. test.)

Test.	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
lbs. 20	6·0	6·2	6·4	6·6	6·8	7·0	7·2	7·4	7·6	7·8	8·0	8·2	8·4	8·6	8·8	9·0	9·2	9·4	9·6	9·8	10·0
21	6·3	6·5	6·7	6·9	7·1	7·4	7·6	7·8	8·0	8·2	8·4	8·6	8·8	9·0	9·2	9·5	9·7	9·9	10·1	10·3	10·5
22	6·6	6·8	7·0	7·3	7·5	7·7	7·9	8·1	8·4	8·6	8·8	9·0	9·2	9·5	9·7	9·9	10·1	10·3	10·6	10·8	11·0
23	6·9	7·1	7·4	7·6	7·8	8·1	8·3	8·5	8·7	9·0	9·2	9·4	9·7	9·9	10·1	10·4	10·6	10·8	11·0	11·3	11·5
24	7·2	7·4	7·7	7·9	8·2	8·4	8·6	8·9	9·1	9·4	9·6	9·8	10·1	10·3	10·6	10·8	11·0	11·3	11·5	11·8	12·0
25	7·5	7·8	8·0	8·3	8·5	8·8	9·0	9·3	9·5	9·8	10·0	10·3	10·5	10·8	11·0	11·3	11·5	11·8	12·0	12·2	12·5
26	7·8	8·1	8·3	8·6	8·8	9·1	9·4	9·6	9·9	10·1	10·4	10·7	10·9	11·2	11·4	11·7	12·0	12·2	12·5	12·7	13·0
27	8·1	8·4	8·6	8·9	9·2	9·5	9·7	10·0	10·3	10·5	10·8	11·1	11·3	11·6	11·9	12·2	12·4	12·7	13·0	13·2	13·5
28	8·4	8·7	9·0	9·2	9·5	9·8	10·1	10·4	10·6	10·9	11·2	11·5	11·8	12·0	12·3	12·6	12·9	13·2	13·4	13·7	14·0
29	8·7	9·0	9·3	9·6	9·9	10·2	10·4	10·7	11·0	11·3	11·6	11·9	12·2	12·5	12·8	13·1	13·3	13·6	13·9	14·2	14·5
30	9·0	9·3	9·6	9·9	10·2	10·5	10·8	11·1	11·4	11·7	12·0	12·3	12·6	12·9	13·2	13·5	13·8	14·1	14·4	14·7	15·0
31	9·3	9·6	9·9	10·2	10·5	10·9	11·2	11·5	11·8	12·1	12·4	12·7	13·0	13·3	13·6	14·0	14·3	14·6	14·9	15·2	15·5
32	9·6	9·9	10·2	10·6	10·9	11·2	11·5	11·8	12·2	12·5	12·8	13·1	13·4	13·8	14·1	14·4	14·7	15·0	15·4	15·7	16·0
33	9·9	10·2	10·6	10·9	11·2	11·6	11·9	12·2	12·5	12·9	13·2	13·5	13·9	14·2	14·5	14·9	15·2	15·5	15·8	16·2	16·5
34	10·2	10·5	10·9	11·2	11·6	11·9	12·2	12·6	12·9	13·3	13·6	13·9	14·3	14·6	15·0	15·3	15·6	16·0	16·3	16·7	17·0
35	10·5	10·9	11·2	11·6	11·9	12·3	12·6	13·0	13·3	13·7	14·0	14·4	14·7	15·1	15·4	15·8	16·1	16·5	16·8	17·2	17·5
36	10·8	11·2	11·5	11·9	12·2	12·6	13·0	13·3	13·7	14·0	14·4	14·8	15·1	15·5	15·8	16·2	16·6	16·9	17·3	17·6	18·0

BUTTER-FAT READY RECKONER—continued.

Test.	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
lbs.																					
37	11·1	11·5	11·8	12·2	12·6	13·0	13·3	13·7	14·1	14·4	14·8	15·2	15·5	15·9	16·3	16·7	17·0	17·4	17·8	18·1	18·5
38	11·4	11·8	12·2	12·5	12·9	13·3	13·7	14·1	14·4	14·8	15·2	15·6	16·0	16·3	16·7	17·1	17·5	17·9	18·2	18·6	19·0
39	11·7	12·1	12·5	12·9	13·3	13·7	14·0	14·4	14·8	15·2	15·6	16·0	16·4	16·8	17·2	17·6	17·9	18·3	18·7	19·1	19·5
40	12·0	12·4	12·8	13·2	13·6	14·0	14·4	14·8	15·2	15·6	16·0	16·4	16·8	17·2	17·6	18·0	18·4	18·8	19·2	19·6	20·0
41	12·3	12·7	13·1	13·5	13·9	14·4	14·8	15·2	15·6	16·0	16·4	16·8	17·2	17·6	18·0	18·5	18·9	19·3	19·7	20·1	20·5
42	12·6	13·0	13·4	13·9	14·3	14·7	15·1	15·5	16·0	16·4	16·8	17·2	17·6	18·1	18·5	18·9	19·3	19·7	20·2	20·6	21·0
43	12·9	13·3	13·8	14·2	14·6	15·1	15·5	15·9	16·3	16·8	17·2	17·6	18·1	18·5	18·9	19·4	19·8	20·2	20·6	21·1	21·5
44	13·2	13·6	14·1	14·5	15·0	15·4	15·8	16·3	16·7	17·2	17·6	18·0	18·5	18·9	19·4	19·8	20·2	20·7	21·1	21·6	22·0
45	13·5	14·0	14·4	14·9	15·3	15·8	16·2	16·7	17·1	17·6	18·0	18·5	18·9	19·4	19·8	20·3	20·7	21·2	21·6	22·1	22·5
46	13·8	14·3	14·7	15·2	15·6	16·1	16·6	17·0	17·5	17·9	18·3	18·9	19·3	19·8	20·2	20·7	21·2	21·6	22·1	22·5	23·0
47	14·1	14·6	15·0	15·5	16·0	16·5	16·9	17·4	17·9	18·3	18·7	19·3	19·7	20·2	20·7	21·2	21·6	22·1	22·6	23·0	23·5
48	14·4	14·9	15·4	15·8	16·3	16·8	17·3	17·8	18·2	18·7	19·1	19·7	20·2	20·6	21·1	21·6	22·1	22·6	23·0	23·5	24·0
49	14·7	15·2	15·7	16·2	16·7	17·2	17·6	18·1	18·6	19·1	19·5	20·1	20·6	21·1	21·6	22·1	22·5	23·0	23·5	24·0	24·5
50	15·0	15·5	16·0	16·5	17·0	17·5	18·0	18·5	19·0	19·5	20·0	20·5	21·0	21·5	22·0	22·5	23·0	23·5	24·0	24·5	25·0
51	15·3	15·8	16·3	16·8	17·3	17·9	18·4	18·9	19·4	19·9	20·3	20·9	21·4	21·9	22·4	23·0	23·5	24·0	24·5	25·0	25·5
52	15·6	16·1	16·6	17·2	17·7	18·2	18·7	19·2	19·8	20·3	20·8	21·3	21·8	22·4	22·9	23·4	23·9	24·4	25·0	25·5	26·0
53	15·9	16·4	17·0	17·5	18·0	18·6	19·1	19·6	20·1	20·7	21·2	21·7	22·3	22·8	23·3	23·9	24·4	24·9	25·4	26·0	26·5
54	16·2	16·7	17·3	17·8	18·4	18·9	19·4	20·0	20·5	21·1	21·6	22·1	22·7	23·2	23·8	24·3	24·8	25·4	25·9	26·5	27·0

BUTTER-FAT READY RECKONER—continued.

Test.	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
lbs.																					
55	16·5	17·1	17·6	18·2	18·7	19·3	19·8	20·4	20·9	21·5	22·0	22·6	23·1	23·7	24·2	24·8	25·3	25·9	26·4	27·0	27·5
56	16·8	17·4	17·9	18·5	19·0	19·6	20·2	20·7	21·3	21·8	22·4	23·0	23·5	24·1	24·6	25·2	25·8	26·3	26·9	27·4	28·0
57	17·1	17·7	18·2	18·8	19·4	20·0	20·5	21·1	21·7	22·2	22·8	23·4	23·9	24·5	25·1	25·7	26·2	26·8	27·4	27·9	28·5
58	17·4	18·0	18·6	19·1	19·7	20·3	20·9	21·5	22·0	22·6	23·2	23·8	24·4	24·9	25·5	26·1	26·7	27·3	27·8	28·4	29·0
59	17·7	18·3	18·9	19·5	20·1	20·7	21·2	21·8	22·4	23·0	23·6	24·2	24·8	25·4	26·0	26·6	27·1	27·7	28·3	28·9	29·5
60	18·0	18·6	19·2	19·8	20·4	21·0	21·6	22·2	22·8	23·4	24·0	24·6	25·2	25·8	26·4	27·0	27·6	28·2	28·8	29·4	30·0
61	18·3	18·9	19·5	20·1	20·7	21·4	22·0	22·6	23·2	23·8	24·4	25·0	25·6	26·2	26·8	27·5	28·1	28·7	29·3	29·9	30·5
62	18·6	19·2	19·8	20·5	21·1	21·7	22·3	22·9	23·6	24·2	24·8	25·4	26·0	26·7	27·3	27·9	28·5	29·1	29·8	30·4	31·0
63	18·9	19·5	20·2	20·8	21·4	22·1	22·7	23·3	23·9	24·6	25·2	25·8	26·5	27·1	27·7	28·4	29·0	29·6	30·2	30·9	31·5
64	19·2	19·8	20·5	21·1	21·8	22·4	23·0	23·7	24·3	25·0	25·6	26·2	26·9	27·5	28·2	28·8	29·4	30·1	30·7	31·4	32·0
65	19·5	20·2	20·8	21·5	22·1	22·8	23·4	24·1	24·7	25·4	26·0	26·7	27·3	28·0	28·6	29·3	29·9	30·6	31·2	31·9	32·5
66	19·8	20·5	21·1	21·8	22·4	23·1	23·8	24·4	25·1	25·7	26·4	27·1	27·7	28·4	29·0	29·7	30·4	31·0	31·7	32·3	33·0
67	20·1	20·8	21·4	22·1	22·8	23·5	24·1	24·8	25·5	26·1	26·8	27·5	28·1	28·8	29·5	30·2	30·8	31·5	32·2	32·8	33·5
68	20·4	21·1	21·8	22·4	23·1	23·8	24·5	25·2	25·8	26·5	27·2	27·9	28·6	29·2	29·9	30·6	31·3	32·0	32·6	33·3	34·0
69	20·7	21·4	22·1	22·8	23·5	24·2	24·8	27·0	26·2	26·9	27·6	28·3	29·0	29·7	30·4	31·1	31·7	32·4	33·1	33·8	34·5
70	21·0	21·7	22·4	23·1	23·8	24·5	25·2	27·4	26·6	27·3	28·0	28·7	29·4	30·1	30·8	31·5	32·2	32·9	33·6	34·3	35·0
71	21·3	22·0	22·7	23·4	24·1	24·9	25·6	26·3	27·0	27·7	28·4	29·1	29·8	30·5	31·2	32·0	32·7	33·4	34·1	34·8	35·5
72	21·6	22·3	23·0	23·8	24·5	25·2	25·9	28·1	27·4	28·1	28·8	29·5	30·2	31·0	31·7	32·4	33·1	33·8	34·6	35·3	36·0

BUTTER-FAT READY RECKONER—continued.

Test. lbs.	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
73	21·9	22·6	23·4	24·1	24·8	25·6	26·3	28·4	27·7	28·5	29·2	29·9	30·7	31·4	32·1	32·9	33·6	34·3	35·0	35·8	36·5
74	22·2	22·9	23·7	24·4	25·2	25·9	26·6	28·8	28·1	28·9	29·6	30·3	31·1	31·8	32·6	33·3	34·0	34·8	35·5	36·3	37·0
75	22·5	23·3	24·0	24·8	25·5	26·3	27·0	27·8	28·5	29·3	30·0	30·8	31·5	32·3	33·0	33·8	34·5	35·3	36·0	36·8	37·5
76	22·8	23·6	24·3	25·1	25·8	26·6	27·4	28·1	28·9	29·6	30·4	31·2	31·9	32·7	33·4	34·2	35·0	35·7	36·5	37·2	38·0
77	23·1	23·9	24·6	25·4	26·2	27·0	27·7	28·5	29·3	30·0	30·8	31·6	32·3	33·1	33·9	34·7	35·4	36·2	37·0	37·7	38·5
78	23·4	24·2	25·0	25·7	26·5	27·3	28·1	28·9	29·6	30·4	31·2	32·0	32·8	33·5	34·3	35·1	35·9	36·7	37·4	38·2	39·0
79	23·7	24·5	25·3	26·1	26·9	27·7	28·4	29·2	30·0	30·8	31·6	32·4	33·2	34·0	34·8	35·6	36·3	37·1	37·9	38·7	39·5
80	30·0	24·8	25·6	26·4	27·2	28·0	28·8	29·6	30·4	31·2	32·0	32·8	33·6	34·4	35·2	36·0	36·8	37·6	38·4	39·2	40·0
81	24·3	25·1	25·9	26·7	27·5	28·4	29·2	30·0	30·8	31·6	32·4	33·2	34·0	34·8	35·6	36·5	37·3	38·1	38·9	39·7	40·5
82	24·6	25·4	26·2	27·1	27·9	28·7	29·5	30·3	31·2	32·0	32·8	33·6	34·4	35·3	36·1	36·9	37·7	38·5	39·4	40·2	41·0
83	24·9	25·7	26·6	27·4	28·2	29·1	29·9	30·7	31·5	32·4	33·2	34·0	34·9	35·7	36·5	37·4	38·2	39·0	39·8	40·7	41·5
84	25·2	26·0	26·9	27·7	28·6	29·4	30·2	31·1	31·9	32·8	33·6	34·4	35·3	36·1	37·0	37·8	38·6	39·5	40·3	41·2	42·0
85	25·5	26·4	27·2	28·1	28·9	29·8	30·6	31·5	32·3	33·2	34·0	34·9	35·7	36·6	37·4	38·3	39·1	40·0	40·8	41·7	42·5
86	25·8	26·7	27·5	28·4	29·2	30·1	31·0	31·8	32·7	33·5	34·4	35·3	36·1	37·0	37·8	38·7	39·6	40·4	41·3	42·1	43·0
87	26·1	27·0	27·8	28·7	29·6	30·5	31·3	32·2	33·1	33·9	34·8	35·7	36·5	37·4	38·3	39·2	40·0	40·9	41·8	42·6	43·5
88	26·4	27·3	28·2	29·0	29·9	30·8	31·7	32·6	33·4	34·3	35·2	36·1	37·0	37·8	38·7	39·6	40·5	41·4	42·2	43·1	44·0
89	26·7	27·6	28·5	29·4	30·3	31·2	32·0	32·9	33·8	34·7	35·6	36·5	37·4	38·3	39·2	40·1	40·9	41·8	42·7	43·6	44·5
90	27·0	27·9	28·8	29·7	30·6	31·5	32·4	33·3	34·2	35·1	36·0	36·9	37·8	38·7	39·6	40·5	41·4	42·3	43·2	44·1	45·0

BUTTER-FAT READY RECKONER—continued.

Test	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
lbs.																					
91	27·3	28·2	29·1	30·0	30·9	31·9	32·8	33·7	34·6	35·5	36·4	37·3	38·2	39·1	40·0	41·0	41·9	42·8	43·7	44·6	45·5
92	27·6	28·5	29·4	30·4	31·3	32·2	33·1	34·0	35·0	35·9	36·8	37·7	38·6	39·6	40·5	41·4	42·3	43·2	44·2	45·1	46·0
93	27·9	28·8	29·8	30·7	31·6	32·6	33·5	34·4	35·3	36·3	37·2	38·1	39·1	40·0	40·9	41·9	42·8	43·7	44·6	45·6	46·5
94	28·2	29·1	30·1	31·0	32·0	32·9	33·8	34·8	35·7	36·7	37·6	38·5	39·5	40·4	41·4	42·3	43·2	44·2	45·1	46·1	47·0
95	28·5	29·5	30·4	31·4	32·3	33·3	34·2	35·2	36·1	37·1	38·0	39·0	39·9	40·9	41·8	42·8	43·7	44·7	45·6	46·6	47·5
96	28·8	29·8	30·7	31·7	32·6	33·6	34·6	35·5	36·5	37·4	38·4	39·4	40·3	41·3	42·2	43·2	44·2	45·1	46·1	47·0	48·0
97	29·1	30·1	31·0	32·0	33·0	34·0	34·9	35·9	36·9	37·8	38·8	39·8	40·7	41·7	42·7	43·7	44·6	45·6	46·6	47·5	48·5
98	29·4	30·4	31·4	32·3	33·3	34·3	35·3	36·3	37·2	38·2	39·2	40·2	41·2	42·1	43·1	44·1	45·1	46·1	47·0	48·0	49·0
99	29·7	30·7	31·7	32·7	33·7	34·7	35·6	36·6	37·6	38·6	39·6	40·6	41·6	42·6	43·6	44·6	45·5	46·5	47·5	48·5	49·5
100	30·0	31·0	32·0	33·0	34·0	35·0	36·0	37·0	38·0	39·0	40·0	41·0	42·0	43·0	44·0	45·0	46·0	47·0	48·0	49·0	50·0